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SUN WORSHIP.

By RICHARD A. PROCTOR.

BEFORE entering on the discussion of a portion of the matter belonging to my subject, "The Unknowable or the Religion of Science," I may explain why for the present I drop that heading. There is a prevalent idea—which is as much as saying there is a foolish idea—that when a student of science speaks about religion he speaks as an opponent. And although my series of papers on the Religion of Science have heretofore not even touched on prevalent religious ideas, the use of a heading in which the word religion occurs is regarded by many, which again is as much as to say that it is foolishly regarded, as indicating that before I have done I shall make some desperate attack on ideas which many regard as especially sacred. Now, as I said at the outset, I have no such intention. I propose only to show how to the student of the universe thoughts essentially religious present themselves, how on the one hand, a power outside ourselves making for righteousness becomes more and more clearly apparent to him the more he studies the past of his race, and how on the other hand recognising the Unknowable as Infinite the nature of the Unknown Reality existing in and through all things as Inconceivable, he has that which all true religion postulates, Infinite mystery, by which mere morality, moved by the emotions, becomes religion. The student of science does not complain when the advocates of contending religions describe the features of their several systems of theology. He is not angry when he sees the many (therefore the unwise) denying the Infinite by limiting It within Personality, or blaspheming the Unknowable by pretending to know that It is moved by mean and paltry passions such as affect themselves. If science, thus recognising prevalent Infidelity,* is silent so far as rebuke is concerned, she may yet be permitted to express her own faith—her belief in an Infinite Power outside ourselves making for righteousness, her recognition of the prevalence of law throughout all space and during all time.

Although probably sun-worship long preceded the full development of agriculture, it was certainly among agricultural races that sun-worship first reached its full development. Men who lived by hunting and fishing, and those still more who trusted to pastoral labours for the means of sustaining life, must have been moved by the glory of the sun, by the impressive beauty of the phenomena attending dawn and sunset, and even by the evidence of waxing and waning might presented by the sun throughout the year. In our dull humid climes we can hardly understand the effect which solar phenomena would have on races living nearly all the time in the open air, and witnessing day after day and year after year the ever-changing glories of the orb which is lord alike of the day and of the year. The phenomena of dawn and sunset in particular are impressive in tropical and subtropical regions to a degree which in our gloomier latitudes we can hardly even imagine. The very animals respond to the touch of the sun's first rays with such a concourse of vocal recognition that by comparison the song of the lark in our own lands seems a tame and feeble tribute to the rising ruler of the day. One might even imagine that some animals, as our near relatives the Gibbons, were moved by a feeling of actual adoration, so earnestly do they welcome, both by voice and by gesture, the rays of the returning sun. Beautiful as are the lines in which our poet laureate describes the dawn of day in England, they would seem utterly tame and unmeaning to one accustomed to the magnificent dawn—the veritable dayspring—of less humid regions. He tells us how

> —— sucked from out the distant gloom
> A breeze began to tremble o'er
> The large leaves of the sycamore,
> And fluctuate all the still perfume.
>
> And gathering freshlier overhead,
> Rocked the full-foliaged elms, and swung
> The heavy-folded rose, and flung
> The lily to and fro, and said,
>
> The dawn, the dawn! and died away,
> And east and west, without a breath,
> Mixed their dim lights like life and death—
> To broaden into boundless day.

A most perfect and realistic description, truly, of the dawn as best known here; but not one word of the glorious colours which flood the skies before the dayspring of tropical and subtropical regions. A Syrian or Egyptian would hardly know that the dawn was meant, in a passage which spoke only of still perfume, freshness, full-foliaged trees, the heavy folded rose, and dim lights mixing like life and death. There is no dimness, no suggestion of death, in the dawn as again and again I have witnessed it in the Carolinas, Louisiana, and Texas, or on the other side of the equator in Australasia. In the tropics the display is even grander, but the changes develope so swiftly that almost ere one has had time to feel their full grandeur, the monarch of day is rising in full glory. In the actual dayspring, again—in sunrise itself—there is something strongly, one might almost say imperatively, suggestive of might and purpose. The sun seems to rise like a living thing, aye like a sovereign monarch. He seems to survey his own realm as his glowing orb rises. And if this is so to the modern student of astronomy, how much more impressive must the scene have been to those who as yet had no knowledge by which the thought could be corrected, that the sun has consciousness and will as well as mere material might.

The first recognition of the sun as a power, not only influencing the fortunes of men but bearing sway over the earth in his daily rule, may well be assigned to pastoral or even to earlier races, though the recognition of the sun as God of the Year belonged probably to agricultural races, and the worship of the sun as a mighty monarch to the development of civilisation. We cannot from any study of the actual methods of worship, deter-

* The student of science who recognises the Power outside ourselves as Unknowable, who admits that he "cannot by searching find out God" is absurdly called an atheist—probably oftenest by people who do not know what the word means: if he cared to descend to calling names, he might much more truthfully apply to those who thus name him, the counter-title—cacotheists.

mine the time to which their origin must be assigned. For customs which had at first no religious significance became developed in the course of time into religious observances; and religious observances, interpreted in a particular way at one time in the history of a race, obtain an entirely different interpretation at another time, and often pass through many changes of meaning before they pass out of use,—if they ever entirely disappear.

Thus we cannot suppose that the Egyptians or ancient Babylonians, had their religion begun with sun worship, would have offered sacrifices to their god, seeing that the idea of offering flesh or meal to the sun, as to a being which could take pleasure in such offerings, would be scarcely less absurd than the idea of offering the flesh of lambs and goats to the Infinite Energy from which all things proceed. But if offerings of food had been made to animals in earlier times, first with very practical ideas as to the utility of such sacrifices and later as propitiatory offerings to animals regarded as deities, it is certain that when sun moon and stars came to be worshipped instead of nearer and less dignified bodies, offerings of flesh meat, of corn, of oil, and so forth, would be made to these new and higher gods, despite their apparent inability to avail themselves of such offerings. If they could not eat the flesh of a burnt offering, the smoke of it, rising to the skies, their home, might reasonably be thought to savour sweetly to them. And so might offerings of meal and oil be pleasant to the gods in the heavens though the substance remained unconsumed—till at least it passed into the possession of the priests who enjoined these sacrifices.

That sacrifices were offered to the sun while as yet he was only regarded as lord of the day, is rendered probable by the continuance of the morning and evening sacrifices among the Jews, even when sun-worship had long since been rejected as an offence—as Job puts it—against the God who is above the sun and moon. It is curious indeed to find Jewish law-givers apparently retaining the very words of the old ordinances, long after these words had wholly ceased to be applicable—so hardly do religious observances die even when the religion to which they belonged has long been wholly dead.

Thus only, as it seems to me, can we explain the strangely archaic wording of the injunctions in Numbers regarding the morning and evening sacrifices, doubtless remnants of the very oldest observances of sun-worship:—"The Lord spake unto Moses, saying, Command the children of Israel, and say unto them, My oblation, my food for my offerings made by fire, of a sweet savour unto me, shall ye observe to offer unto me in their due season. And thou shalt say unto them, This is the offering made by fire which ye shall offer unto the Lord; he-lambs of the first year without blemish, two day by day for continual burnt offering. The one lamb shalt thou offer in the morning, and the other lamb shalt thou offer at even; and the tenth part of an ephah of fine flour for a meal offering, mingled with the fourth part of an hin of beaten oil. It is a continual burnt offering, which was ordained in Mount Sinia (!) for a sweet savour, an offering made by fire unto the Lord. And the drink offering thereof shall be the fourth part of an hin for the one lamb; in the holy place shalt thou pour out a drink offering of strong drink unto the Lord. And the other lamb shalt thou offer at even: as the meal offering of the morning, and as the drink offering thereof, thou shalt offer it, an offering made by fire, of a sweet savour unto the Lord."

How long these offerings continued, and how vain they were thought by the more advanced minds, we can judge by the impassioned language of Isaiah, "Hear the word of the Lord; to what purpose is the multitude of your sacrifices unto me? saith the Lord. I am full of the burnt offerings of rams and the fat of fed beasts; and I delight not in the blood of bullocks, or of lambs, or of he goats." But such teaching was of no avail among the unreasoning many in his day, any more than it would have been in the days of sun-worship, or indeed than it would be now. Doubtless he was regarded as an enemy of religion in his own time, however he came to be reverenced when the opportunity for following his precepts had passed away. His rejection of what nearly every one in his time accepted, was no doubt looked on as implying agnostic if not atheistic ideas.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

V.—THE PAST LIFE-HISTORY OF THE EARTH (*Continued*).

THE *Devonian* and *Old Red Sandstone* rocks, while evidencing to frequent redistribution of sea and land, have undergone, as compared with the older systems of the Primary epoch, but slight disturbance from the upheaving and contorting agencies beneath. They are widely diffused, extending far north within the Arctic circle, and although their fossil contents are very incomplete, they bring less fragmentary witnesses to that continuity of life which is so markedly broken in more ancient deposits. This is specially apparent in the relative abundance of vegetable remains, by which we may for the first time construct some picture of plant-life on the globe in the Palæozoic epoch. Not only do we find huge tree-like plants of which our club-mosses and ferns are pigmy representatives, but true trees, as proven by the concentric rings of growth in their trunks. Of land animals, the preservation of which is so rare in all deposits, there are no traces; no reptiles wallow in the lagoons and marshy flats, neither are the verdant yet flowerless forests brightened by the plumage, or their stillness broken by the song, of birds. Some happy chance, like that which envelopes the insects of Tertiary forests in amber—the fossil gum and resin of their trees—has preserved the fragile wing of an insect with the drum or stridulating organ attached, as in the grasshopper, &c., wherewith then, as now, mates were attracted or rivals challenged; perchance "the first music of living things that geology reveals."

Freshwater fossils abound; but the dominant types are marine; large sponges and corals; "lamp-shell" mollusca, which have persisted in varying forms from Cambrian times till the present; crustaceans huger than any that have lived since, and of which even the spawn-masses are sometimes preserved. More or less special types appear, and then vanish, through inability to adapt themselves to new surroundings and changed climates. But the Devonian is notably the "Age of Fishes," and its waters swarmed with the ganoid or armoured type.

Coal is formed of compressed and chemically-altered plants, and therefore occurs in all water-laid rocks, although in very different states and kinds. The climate and soil, during long eras of the *Carboniferous* system, specially favoured the growth of plants most fitted for its formation. A large part of Europe (and the like conditions apply wherever the true coal-measures abound) was then covered with shallow waters, both salt and

fresh, divided by low ridges—bases of future mountain chains—and dotted with islands; numerous rivers traversing the land and silting up lagoons and lakes with the *débris* worn from older rocks. Vegetation flourished apace on these river banks and marshy flats, and, with intermittent subsidence of the soil occurring again and again, was buried under sand and mud, and changed into coal of varying seams of thickness. Hence the abundance of this mineral in the Carboniferous strata, which, as a whole, yield more of value and variety for the service of man than all the other systems put together. Sandstones for building, marbles for decoration, metals for machinery, coals wherewith to drive them, purest oil from muddy shale, loveliest colours from tar, jet for the lapidary's art—these are the rich gifts of the deep rocks.

Of the plants forming the coal-measures, the larger number are obliterated, but they all belong to the lower orders, as do the club-mosses, tree-ferns, and other forms, which, in the warm, moist atmosphere of those times, reached a gigantic size, and had a worldwide range, even far into Polar regions, where coal-seams have been found. Of the animal life that dwelt amongst them we know very little, nor do the extant fragments represent a tithe of the forms then flourishing; in the later deposits the lower sub-kingdoms are represented by spiders and large scorpions; by land-snails, beetles, may-flies, and other insects; while the first-known land vertebrates appear in the salamander-like and long-extinct amphibians called Labyrinthodonts, from the labyrinthine structure of their teeth.

As usual, the marine remains are dominant. The lower types persist; the trilobites are on the verge of extinction, but higher forms of the same group, allied more nearly to the lobster and the shrimp, succeed. Forerunners of the beautiful ammonites appear, and the fish, while still of the armoured species, have a more reptilian character than their Devonian ancestors.

The life-features of the *Permian* system, the last division of the Primary epoch, differ but little from those of the Carboniferous; the only, although important, distinction is in the remains of true reptiles with crocodile-like characters.

We now leave the Primary epoch, and enter the Secondary epoch, with its widely different features and contents, explicable only by a great break in the succession of strata, and by an enormous lapse of time for the modification of the life-forms. Although, as in every period, volcanic action is manifest, the igneous rocks being pushed through the strata, or now and again alternating with them, we meet with few traces of the metamorphism which so baffles examination of the earlier rocks; we can mark more definitely the boundaries of land and water; measure more accurately the changes; and trace more clearly the relations between the successive life-forms, of which the marine are the preponderating, and the reptilian the most marvellous.

In the earliest division of this epoch, the *Triassic*, many of the leading Palæozoic types are extinct. Several plants of the Coal and Permian systems have disappeared, and the flora consists mainly of ferns, of cycads or palm-ferns, and of coñifers, or pines and firs, to which the cycads are allied. Among the invertebrate animals, certain molluscs are no longer found, but there is an intermingling of old and new types. Oysters and whales and members of the cuttle-fish group are abundant. As yet the fishes show no marked advance in structure, and the Amphibia are changed only in size, as their enormous footprints show. Reptiles allied to the crocodile group are now the dominant type; and sea-lizards, which attained gigantic size in later periods. Whether certain bipedal footprints in the Triassic sandstones are those of birds is doubtful; perhaps they are tracks of reptiles with bird-like movements. But, in the absence of proof that they are due to birds, which certainly preceded mammals in the succession of species, a great link is missing in the Trias, since that system has yielded teeth of the earliest known mammal. It was probably of the marsupial or pouched species, a transitional form now represented most nearly by the Australian phalangers and the American oppossums.

The *Jurassic*, or Oolitic, system occupies extensive areas in both hemispheres, and ranges from the Arctic circle to Australia. Its strata, largely composed of coral growths and other organic remains, are rich in special life-forms which are limited to the Secondary epoch.

Its seas, which overspread the greater part of Europe, covering the large salt lakes of the Trias, swarmed with exquisite spiral ammonites, large and small; with conical bolt-like belemnites, allied to the cuttle-fish group; with lobsters, prawns, and crabs, which succeeded the trilobites and other crustaceans; with ganoid fishes, sharks, and rays. And "there were giants in those days"; monsters of the deep in the ferocious sea-lizards, with their fish-like bodies and flipper-like limbs; monsters of the land, too, of dread aspect and size seen neither before nor since; one found in North American beds being, it is computed, more than one hundred feet in length and above thirty feet in height. There were flying lizards, winged like bats, hollow-boned like birds, and with claws, skin, and, teeth like reptiles; and it is in a Jurassic limestone stratum that the oldest known true bird, a creature about the size of a rook, is found. It does not correspond to any known past or present birds, but represents a transitional type, having both bird and reptile-like characters. In addition to free claws to each wing, the tail is long, and made up of separate bones or prolonged vertebræ, a feature noted in the embryos of birds and mammals, the significance of which will appear later on.

Therefore, while the sea, then, as ever, was the more thickly peopled, the land had now a far more important air-breathing population both of small things and great. The hum of insect-life filled the cycadaceous forests, butterflies sported in the sunshine, spiders spread their webs for prey, and the remains of marsupials point to the range of these small but highly-organised creatures over Western Europe. The plants and animals of these islands in Jurassic times probably resembled those still found in Australia, which, by reason of its long isolation from other continents, has preserved in its pouched mammals, its sharks, its mud-fish, and its cycads, more ancient life-forms than any other country.

The vast chalk formations of the globe are the typical features of the *Cretaceous* period (Lat. *creta*, chalk), when the sea overspread a large part of Europe, Asia and Northern Africa, receiving on its floor the foraminiferal shells which were converted into chalk, just as at this day chalky ooze is being deposited at the bottom of the Atlantic. Molluscs, nautiluses, belemnites, ammonites, some of them the size of a cart-wheel, swarmed in its waters; and with them the huge reptiles of Jurassic times, sea-lizards and sea-serpents, ganoids and sharks, and, what is important to note, bony-skeletoned fish allied to the salmon, herring, and perch families.

In the North American formations, which have so added to our knowledge of ancient life-forms, "dragons of the prime," crocodile-like, bird-like, bat-like, are found, as also the remains of true birds, these last being

rare in the Old World. Little trace of the Cretaceous land-areas remain, but the plants of the upper strata resemble existing vegetation; in the words of the science books, Angiospermous exogens appear, which in the vulgar tongue means leaf-bearing trees having a true bark (except cone-bearers), and growing from the outside, with their seeds enclosed in a vessel, as the oak, beech, willow, fig, walnut. They are called "exogens" in contrast to "endogens," or palms, grasses, and lilies, which have no true bark, and grow by additions from the inside.

Of the total thickness of the stratified rocks, estimated at 130,000 feet, the Secondary systems occupy only 15,000, or $8\frac{2}{3}$rds of the whole. But, as this abstract of their contents shows, their importance is not to be measured by the space which they fill. Whether or not transitional forms, which from their nature had a shorter range of time and less chance of preservation, existed in the Primary systems, we cannot say, for life is older than its records. But it is in the Secondary, when, as the coal-seams and coral deposits of extreme northern zones show, warm climates prevailed, that the marked advance in specialisation of plant and animal forms is manifest.

PHOTOGRAPHING FIFTEEN MILLION STARS.

By Richard A. Proctor.

A MAGNIFICENT suggestion has been made by French astronomers. Already in these columns the work done by the photographic eyes of science, directed towards the heavenly bodies, has been dealt with. By the power of instantaneous vision which the photographic eye, unlike the human eye, possesses, the sun's cloud-laden surface has been delineated, despite the constant fluctuations of the air through which the sun has to be viewed. By the power of selecting special colours wherewith to work, the photographic eye has drawn the corona when no trace of that solar appendage has been visible to ordinary eyesight. The delicate features of the star-clouds have been depicted, through the power which the photographic eye possesses, of seeing more and more by long-continued gazing upon faintly luminous objects. And now it is proposed to do what assuredly no astronomer, nor any band of astronomers, could hope to effect, even if working for the whole duration of the longest life. It is proposed to chart in their true positions all the twenty millions or so of stars which are included in the first fifteen magnitudes, so that the astronomers of future generations may know for certain the aspect of the stellar heavens—to that vast depth, at least—towards the close of the nineteenth century. Let us see what are the conditions of the task.

Using a telescope provided with a specially prepared object-glass of about 13 inches in diameter, MM. Paul and Prosper Henry have been able to take in a single hour photographic charts of spaces in the heavens extending 3 degrees in length and $2\frac{1}{4}$ degrees in breadth—say six moon-breadths by four and a half. Their actual plan has been to give in each case three exposures, with such slight displacements that each star is tripled, and so there can be no possibility of mistaking accidental dots on the plate for stars in the heavens. (It might be well, however, if in the photographs finally prepared only single images of each star were given, a preparatory plate with triple images serving for the correction of the one finally prepared, which might have three hours of exposure without displacement.) Now, a space of 3 degrees by $2\frac{1}{4}$ degrees on the heavens, or $6\frac{3}{4}$ square degrees, is about 1-6,112th part of the whole star-sphere. So that if twelve observatories, in different parts of the northern and southern hemisphere, were employed to photograph the star-sphere on one and the same plan, then at each observatory only about 510 plates would have to be made. Counting about fifty-one moonless nights of clear sky and still air, one night being given to each plate, the whole work would be completed in ten years. If the charts thus obtained could be combined in sets of four, in the manner already employed by MM. Henry, there would be 1,528 sheets, each representing a portion of the heavens, extending 6 degrees by $4\frac{1}{2}$; but although Admiral Mouchez suggests this plan as desirable, it appears open to exception on account of change of scale near the edges of the plates.

The number of stars which would probably be shown in this splendid contribution to the astronomy of the future would be about twenty millions. In a single plate, obtained by MM. Henry recently, nearly 5,000 stars can be counted; and if 6,112 gave each such a number—say 6,000 times 5,000—that would be 30 millions of stars. But the region shown in this particular plate belongs to a rich part of the Milky Way, and it has been shown by my chart of 324,000 northern stars down to the 10th magnitude, that there is a much greater density of stellar aggregation on the Milky Way long before the space-penetrating powers have been employed which the Herschels thought probably necessary to reach the regions whence the nebulous light of the Milky Way was supposed to proceed. If the photographic method were applied uniformly over the whole heavens, with a space-penetrating power reaching stars of the 15th magnitude in all directions, it is probable that about 20,000,000 stars would be shown. The great gauging telescopes used by the Herschels would show at the very least 100,000,000—or rather would have shown that number if it had been possible to bring every portion of the star-sphere under their survey.

A new era of stellar astronomy will open with this photographic work. The problems connected with the architecture of the heavens, hitherto dealt with by very imperfect methods, will now be discussed with all the advantage of at least a perfect system of survey. It is impossible, indeed, to overestimate the advantage of a system of charting over all the methods of statistical research which astronomers formerly employed. William Herschel in his first method counted all the stars which one and the same telescope—a very powerful one, 18 in. in diameter—would show in different directions. He could only take a field of view here and a field of view there, not many hundreds in all, his son and worthy successor in the work making similar observations in the southern hemisphere. No peculiarities of arrangement, nothing, in fact, but the roughest features of stellar distribution, could be recognised by such a method as this. It showed, however, how vast the number of stars forming our galaxy is, and it satisfied Sir W. Herschel that the assumption by which he had proposed to interpret his numerical gauges was inadmissible, the stars not being strewn throughout our galaxy with any approach to uniformity. Herschel's second method, commonly confounded with his first (insomuch that one may often find even men like Arago and Humboldt mixing up in the same paragraphs the results of both methods of observation) was entirely different. He

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now no longer trusted to the use of the same telescope, turned in different directions, to tell him (after mere counting) the depth of our galaxy of stars in those directions; he turned different telescopes, gradually increasing the space-penetrating power, in the same direction, to tell him, by the power required to resolve the whole field of view into stars, the probable extension of the system in that direction. Herschel made many observations by this method, but in his advanced old age, when these observations had been gathered together, he did not recognise the absurdity of the result to which they tended, on the assumption he had employed. He found regions of the star-sphere, for instance, wherein stars of all orders were richly strewn, from those visible to the naked eye down to the faintest which his most powerful telescopes could show, and fainter orbs yet, whose lustre could only be recognised as milky nebulosity (resulting from the combination of the light of many stars separately undiscernible). Around these rich regions were regions comparatively poverty-stricken, regions deserving the description applied by the younger Herschel to the spaces around the Magellanic Clouds, of which he wrote that "the access to the nubeculæ is on all sides through a desert." If his assumption had been correct, these seeming clouds of many varied orders of stars, brought into view successively with increase of telescopic power, would be long cylindrical star-clusters, or rather spike-shaped projections of star-strewn space, hundreds of times longer than their thwart breadth, and chancing by some strange accident to have their axes directed exactly towards our place in the star system. Unlikely, one may almost say incredible, in a single case, this peculiarity would be utterly impossible in several; and the clouds so to be interpreted (if Herschel's assumption were retained) are many.

Obviously we must reject this porcupine theory of the stellar system, with the solar system for the "pole" of all the stellar spines. We see that the rich cloud-like regions are real clouds of stars of many varied orders, and that in each case where Herschel had assumed (though only tentatively) that he was penetrating further and further into space, he was in reality only analysing more and more scrutinisingly a complex cloud of stars. His position might be compared to that of an observer trying to gauge our solar system from a distance, who might naturally assume at first that the giant planets were much further away than the sun, the terrestrial planets much further away than the giant planets, the asteroids than the terrestrial planets, the meteorites than the asteroids, the small meteors than the meteorites, and the still smaller particles in comets' tails than meteors; such an observer, as soon as he recognised the association of all these objects into a system, would see that, instead of attributing the variety of aspect within the system to the variety of distance, he must regard it as due to real variety of size. The meteors which he had interpreted as millions of times more remote than the giant planets, he would now find to be in many cases close alongside of those large bodies, and, on the average, no further away than the chief orb in the system, the great controlling sun. In like manner the faintest stars in the great clustering regions of the Milky Way are, on the average, no further away than the leading orbs in the same star-clouds (which, be it noticed in passing, is by no means the same as saying that the fainter stars of the stellar depths are, on the average, no farther away than the more conspicuous). The assumptions made by the elder Herschel, though shown as his work proceeded to be mistaken, did not prevent his accumulated results from being most valuable. But the validity of statistical methods was shown to be doubtful. The assumptions of Wilhelm Struve were still more improbable antecedently, and still more thoroughly discredited by the evidence. He took a zone of the heavens 30 degrees wide, assumed that the stars (down to the eighth magnitude) might be supposed to be first compressed along the mid-line of that zone, and then strewn out uniformly in twenty-four sectors, into which he divided the circular area enclosed by that mid-line. This naturally led to a result having no validity whatsoever.

The fault of all such statistical methods is that in effect they depend on a process of averaging by which, even if the initial assumptions were trustworthy, the significance of all the actual peculiarities of stellar architecture would be concealed. We want to have these peculiarities emphasised rather than hidden. Charting alone can do this effectually. But who can pretend to chart the whole heavens to any great depth around our solar system? Struve used in his statistical inquiries about 70,000 stars, and I has shown in a single equal-surface chart 324,000; but what are they among tens of millions of stars within the range of Herschel's gauging telescopes? That single chart required first seven yesar of observatory labour by Argelander and his assistants, then 400 hours of charting by myself; yet it shows only stars down to between the ninth and tenth magnitudes, and even in regard to these is affected by all the variations arising from the "personality" of the different observers. The proposed photographic survey would extend very much further into surrounding space, would be far more trustworthy, and would be entirely independent of "personal equation." The idea is a magnificent one, and it may be hoped that the astronomers of all nations will help in carrying it out.—*Times.*

EVOLUTION OF LANGUAGE.

By ADA S. BALLIN.

III.—SENSE-CHANGES.

LANGUAGE may be regarded as a tool of the human mind, an instrument serving two fixed purposes—namely, the expression and record of thought. The changes in the pronunciation of words may be compared to the wearing down and smoothing of the handle of such a tool which renders it more easy and comfortable to work with; but there are changes of more importance than these—namely, changes in the method of using the tool in which it is adapted perforce to the new purposes it is required to serve. As new ideas are evolved, it is found necessary to express them, and to this end old words are adapted, or, as it were, attached to the new meanings by a process based on the principle of SIMILARITY. In like manner, as I pointed out when speaking of the deaf and dumb,* that their chief means of communicating ideas was by indicating likeness, as by touching their lips to express "red," so with verbal language, new ideas are expressed by describing them in terms of the old. Thus it is that the meaning of words change by their being applied to ideas other than those which they formerly expressed. The similarity which

* KNOWLEDGE, vol. VII., in the series on "Thought and Language."

first caused the adaptation of an old word may, to an analytical mind, often seem very faint, although sufficiently apparent to the mind of the child or uncultivated man. By metaphor we speak of the *eye* of a needle; *ness* at the end of geographical names is derived from *nez, nose*, for a promontory of land. *Donkey* is the diminutive of *dun*, a horse; *daisy* is by a poetical figure *day's eye* (Saxon, dagges-ege); and the South Sea Islanders used to speak of man as *long pig*—a name said to be based on similarity of flavour. In like manner as among the deaf and dumb* single characteristics are taken to express the whole idea, as *snow* for *winter*, *petticoat* for *woman*, in Latin a *scale* for a *fish*, *sail* for a *ship*. Thus we speak of *bile*, meaning anger in the sense that Horace used the word *stomachius*. The word *savage*, in the sense of fierce, is derived from *savage*, meaning a wild man or animal, from the Latin *silvatico*, woodland, in the original sense of being reared in the wood in opposition to domestic, brought up in the house, or cultivated. A *junketting*, or merrymaking, is derived from the Latin *juncus*, a reed, through the Italian *junkala*, a cream cheese put up in reeds, and originally meant a party invited to partake of the comestible called *junket*. Our word *spirit* has the various significations:—Alcoholic liquor, courage, ardour, soul, ghost, and most immaterial things. French *esprit* is derived directly from the Latin *spiritus*, literally a blowing of the wind or breath; the word *ghost*, connected with our *yeast*, is also derived from a word meaning breath or blowing. The word *mail*, French *malle*, a trunk, means a box or bag for the conveyance of letters, also the coach or carriage in which the bags are conveyed; and we now talk of catching the *mail* when we mean being in time for the steamer or the train, or receiving the *mail* when our foreign letters arrive. The word *brim*, which we use for the *brim* of a hat, the *brim* of a glass, the *brim* of a fountain, and when we speak of tears as *brimming* over from the eyes, is derived from a Sanscrit root, *bhram*, meaning to whirl about, used in the sense of the surge of the sea, and thence by a natural transition of the borderland between the sea and the dry ground, the part where the waves whirl about the most, the *edge* of the water, thus reaching the sense in which we employ it.

The power of seeing likeness in diversity, which is the cause of words being used metaphorically, is strongest in uncultivated minds, such as those of savages and children. Thus, the little boy Clifford, whose early stages of development have been chronicled by Mr. Lully, at seventeen months began to have abstract ideas of form, and to express them. Having learned the word *bŏ* for indiarubber ball, he applied it to oranges, and afterwards to bubbles on a glass of beer. He saw likeness to the exclusion of difference, and formed a word for it, just as the Tasmanian calls everything *round*, "like the sun," by naming it after the round object most familiar to him. At twenty-one and a half months, Clifford called all triangular objects "ship," because the feature which had most attracted him about a ship was the triangular sail. He was so apt at observing similarities that when eighteen months old he saw his sister dipping a crust in her tea, he exclaimed *ba!* (boat) with much delight; seeing a dog panting after a run, he said, "dat bow-wow like puff-puff;" and of a ship he saw sailing, he said, "dat ship go marjory daw" (indicating the rocking movement by a simile from the poem, "See-saw, marjory daw"). As a still more striking example of the tendency to see similarity above difference, he called the needle in his father's compass "bir" (bird), detecting a resemblance in its fluttering action, which our more analytic minds would overlook.

It is to the same mental process here illustrated in the case of this child that language is mainly developed in the race. We talk of an *axle-tree* or of a *family tree* by a metaphor growing out of the idea of branches represented by the spokes of the wheel and the members of the family. Again, we talk of the *root* of the tongue, the *uprooting* of a superstition, the *root* of a figure in mathematics, the *root* of a word, by metaphor from the original meaning of the *root* of a tree or plant. In the first case, the point of similarity is the idea of fixedness, the second case that of destruction, by removing the growth from the place where it is nourished; in the others the idea is that of fundamental element.

The succession in the sense-changes of words is like a chain of many links. If we have only the first and last links we do not see how to connect them; but a careful search and fitting together will frequently reveal the connection. The series of changes is not necessarily a conscious one. Seeking to express an idea as yet unnamed, a word is chosen which has been used for some idea similar to it. This word is adopted, and in its new sense becomes a part of language, and gradually the old sense is forgotten and drops out of view. Then the word may be reapplied in another sense, and its second meaning also drop into oblivion, and so on. In this way a word may eventually come to possess a meaning totally opposed to its original sense. Thus, for instance, the German word *schlecht* originally meant good, *ein schlechter Mann*, a good fellow; then plain, simple, foolish, mean, base, bad. The French *bon* has a somewhat similar history, for, besides good, it means simple and silly; *bonhomme* means simple fellow, vulgarly old buffer or old codger, and *la lui garder bonne* is to owe any one a grudge. When we speak of a *pen* we now mean a steel pen, ignoring the origin of the Latin word *penna*, a feather, so far as to ask for a *quill pen* if we require that kind. When speaking of the *salary* of an employé we mean a sum of money, and never for a moment imagine that the word is derived from the original custom of paying the Roman soldiers for their service in *salt*. Our words *romance* and *romantic* have also a curious history. In the Middle Ages, poems for popular recitation by the troubadours were composed in the vulgar language, which, at that time, was the Romance dialect. These poems were mostly of an imaginative or fabulous character, and by the 16th century a fabulous tale was already called a *Roman*, thus we have *Le Roman de la Rose*. From this signification to that of *work of fiction* was but a step, and we now call some events in real life *romantic*, because they resemble those which generations of novelists have led us to associate with the offspring of their brains.

An amusing example of the diversity of meanings which one word, by analogy and metaphor, may be made to cover is given by Whitney, who says, "Not only an animal has a *head*, but also a pin, a cabbage. A bed has one, where the head of its occupant usually lies—and it has a *foot* for the same reason, besides the four *feet* it stands upon by another figure, and the six *feet* it measures by yet another. More remarkable still, a river has a *head:* its highest point—namely, where it heads among the highlands—and so it has *arms;* or, by another figure, *branches;* or, by another, *feeders;* or, by another, *tributaries;* and it has a right and a left *side;* and it has a *bed*, in which, by an unfortunate mixture of metaphors,

* See "Thought and Language" XI., Knowledge, vol. vii., p. 516.

it *runs* instead of lying still; and then at the farthest extremity from the head we find, not its *foot*, but its *mouth*. Further, an army, a school, a sect, has its *head*. A class has its *head* and its *tail;* and so has a coin, though in quite a different way. A sermon has its *heads*, as divided by their different *headings*, and we can beg to be spared anything more on that *head*. A sore comes to a *head;* and so, by one step further away from literalness, a conspiracy, or other disorder in the State, the *body* politic, does the same. We give a horse his *head*, which he had before our donation; and we treat in the same way our passions—that is to say, if by their overmastering violence we lose our *heads*. And so on, *ad infinitum*.*

Under this all-embracing class of changes by similarity of meaning may be included minor changes which I will call (I.) quantitative and (II.) qualitative changes of meaning. The implication of words may change by enlargement or by diminution. As examples of the former, the Romans called all their emperors Cæsar, and eventually the name was applied to those who could claim relationship to the royal family, the origin of the title dating back to the name of the First Dictator—Caius Julius Cæsar. More recently the Germans have adopted the name in the general signification of *Emperor* (Kaiser), and the same word is apparent in the Russian Czar.

The English word panic is derived from the proper name of the heathen god, Pan, and was formerly used in English in connection with the word fear, *panic-fear* meaning Pan-like fear. In French the word *épicier* is derived from only one of the things the grocer sells—namely, *spice*. Our *anguish*, a word expressive of painful emotion, is derived from the Latin *ango*, to choke, in reference to the well-known physical sensation at the throat which accompanies an excess of grief. From the same root comes also the Latin *angustis*, narrow, referring to the narrowing of the windpipe produced by throttling.

As examples of diminution in the implication of words, the following will suffice:—*Grocer* meant a man who sold things by the *gross;* but the present meaning of the word is far more limited. *Spices*—Latin, *species*—originally meant miscellaneous goods. The modern Greeks use the word *alogon* for *horse;* but this word meant originally any irrational or non-speaking animal.

II. Words improve and deteriorate in signification. Changes for the better are somewhat rare. Such are, *chivalry*, which originally meant simply *horsemanship;* *loyal*, a good sense grown out of the word legal. *Humble*, originally meaning poor-spirited, is now used to express a desirable frame of mind. *Christian*, now a term of praise, was with Tacitus and Pliny one of opprobrium.

Words change for the worse either by euphemism, the tendency not "to call a spade a spade," so that good words are frequently applied to vile uses, as, "to have a few words" means to quarrel; "to take a drop too much," to get drunk†; or on the principle of "be not wise overmuch." Thus, to be *busy* is good; but to be a *busybody* is not desirable. Goody-goody is used for hypocrite, and the German *selig*, blessed, innocent, comes to be our *silly*.

In such word-changes as these may be found the story of the mental and historical development of the race that effected them. Starting as the mere expressions of sense perceptions, words become by the elastic power of the human mind, and on the principle of similarity, the embodiment of wholly abstract ideas. The word *justice* is derived from a primary idea of *straight*, like *right*, Latin *rectus*. *Wrong* is literally wrong, or twisted from the right or straight path. A *concept* is a taking together. To *imagine* is to make a mental *image* of anything. *Nothing* is *no thing*, like the Latin *nihil*, *ne filum*, no thread, meaning not even the slightest thing. *Angel* is from a Greek word meaning messenger; *spirit*, as I have said, is from a word meaning breathing, whence also our *respire* and other derivatives. The primary sense of *hope* is to stretch or reach forward, and by a similar metaphor we say we *long* for an event. *Religion* is a binding together, *superstition* a standing upon. These few words, taken at random, serve to show how linguistic development may take place by the adaptation of old words to new ideas, and the ignoring of their earlier signification. What is called figurative language, the language of the poets, is guided by the same principle, and it is in this respect that translators generally fail by trying to render the words themselves instead of the ideas they embody. Literal translations are, for this reason, failures. Take, for instance, the phrase in Ecclesiastes rendered by the old Authorised Version, "Vanity of vanities, all is vanity and vexation of spirit." How could any one have the heart to translate it according to the literal meaning of the original Hebrew text: "Smokiest smoke, all is smoke, and badness of breath"? At the present time in a London fog this translation is certainly a striking metaphor, but the former would be generally considered the more poetical rendering of the poet's thought. The figurative nature of language is especially clear in Hebrew. Thus *zaken*, *old*, is literally *bearded*, as with the deaf-mute; *khoshun*, *darkness*, is used to mean *misery*, *adversity;* *yazad*, to *place* a building, means metaphorically to constitute, establish laws. *Naphesh*, breath, comes to mean vital principle, soul, mind, also life, living thing, animal, body, person, and so on. In every language words serve to express a variety of meanings, and their signification is gathered from the connection in which they appear. So much is this the case that if there is occasion for extreme precision in speech it becomes necessary to define the particular sense in which the chief words are read.

No two persons have precisely the same range of thought or of language, nor do all attach the same meaning to the same words. Words are not perfect models of ideas, but merely signs of them, just as coins are the signs of certain values. The meaning and application of words is frequently misunderstood—thus a young child calls every man *papa*, taking that word to mean a certain group of characteristics which it sees in all. The variations of meaning possible are much greater in some classes of words than in others—smallest in words expressive of mere perceptions, largest in abstract words; but always dependent on the experience and mental tone of the speaker. The same language includes individual varieties, class varieties, and local varieties. No two Englishmen, for example, speak precisely the same language, either in form, extent, or meaning. Still greater variations are found between, for example, a member of the class lawyer and that of agricultural labourer; and locally we branch into dialects, as those of Yorkshire and Somersetshire. Any two English people may talk

* "Life and Growth of Language," Ed. 1879, pp. 86-7.

† Mr. David Christie Murray, in his very interesting novel, 'Rainbow Gold" (Vol. II., p. 232), represents the landlord of a country inn as saying of a customer given to swearing in his cups, "He uses language, which is a thing as I cannot abide. I'll have no man usin' language i' my house." Here, of course, language is used in the sense of *bad* language.

so as to be unintelligible to each other, but all can make themselves understood on subjects of general interest. Each individual does his part to propagate his language, and each generation hands it down by tradition to the next, although in a form somewhat different from that in which it received it; but literature, besides having a powerful influence on the language of individuals, as it were stereotyped that of its authors, and is a conservative element in the ever-changing current of human speech. No individual can affect speech except by setting an example which others follow, for no change in language can take place without the help of the people, and it is thus that each language becomes an index to the average and collective capacity of the community to which it belongs; for a nation developes language only in relation to its needs.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

THE appearance of the first part of a splendid work on "Rotifers," by Dr. Hudson and Mr. Gosse, will excite fresh interest in the study of these wonderful and most fascinating objects for the microscope. The new work is necessarily somewhat costly, but, from the beauty and elaborate character of the coloured plates, it will compare very favourably in point of price with any other first-class monogram.

Every collector of the minute objects of pond life is sure to meet with some typical species of this interesting family, but many are very local; and although, as the preface to the new work states, upwards of ninety species have been discovered since the last edition of Pritchard's "Infusoria" was published, twenty-four years ago, it is by no means probable that even the English list of fresh-water kinds is yet completed.

If the question is asked, "What is a rotifer?" no simple answer can be given, because the characters of different species vary so greatly and so widely that the details common to all are comparatively few, and often difficult to observe. The earliest and best-known member of the family is the *Rotifer vulgaris*, or Common Rotifer, found not only in ponds, but in gutters, tufts of moss, &c., and able to survive and become reanimated after being dried up and passing an indefinite time in mummy-like repose.

The early microscopists were greatly astonished when they saw this creature thrust forth organs which appeared to twirl round on axes, just like watch-wheels. Of course, a little reflection must have led the observer to conclude that this appearance could not exactly conform to reality, but with the imperfect instruments of early date, it must have been very difficult to find out what did actually take place; and at this day, if a common rotifer is shown to any one ignorant of its nature, the motion of its cilia is pretty sure to draw forth the exclamation that a pair of wheels are spinning round.

It is impossible to understand ciliary motion by observing it in a rapid condition, but any of the larger ciliated creatures common in hay infusions enable it to be studied and analysed as they become enfeebled, if a water-drop containing them is permitted to get nearly dry. Each cilium then shows its separate motion, which is found to be much like what can be given to a long elastic stick by a brisk movement of the wrist. It is a wave motion from base to tip, and when a number of cilia move in rhythmical succession they look like wheels, if they are arranged in a circular pattern, and like advancing waves in an elongated one.

It is impossible to state how low down in the scale of living things some rudimentary state of consciousness exists, but when we come to the higher rotifers, many of their actions look as if they were guided by intention for a definite purpose, and on one occasion I saw a fight between a Diglena and an Anguillula. The latter seemed to have offended the rotifer by giving it an accidental flick, to which the rotifer responded by thrusting out its mouth and trying to bite the worm to pieces, in which it partially succeeded. I speak of its "mouth," because in this and some other species the biting organ, commonly called "a gizzard," can act as an external organ with protruding jaws. Generally speaking, the "gizzard" corresponds more or less with the mouth of insects, as Mr. Gosse showed long ago.

Ciliary vibration to bring food-particles within reach of a creature's mouth may be a very simple business. The currents set up in such cases merely have a general tendency to throw floating particles so that a good many cannot help going through the right way, while, perhaps, the majority are hurled far astray. If, however, the proceedings of a common rotifer are noticed, it will be seen that the actions are much more complicated. The so-called wheels can be moved in various directions, and when their whirlpools have entangled small objects of all descriptions, another set of cilia, exerting a selective power, form currents which rapidly take what the creature desires down through the gullet to the so-called gizzard, and thence to the stomach, and reject the rest. When a number of common rotifers, or of other highly-developed free-swimming species, such as the Brachions, are seen near each other in one trough, considerable differences of what would be called skill in more advanced creatures may be frequently noticed, and some might be reckoned much more clever than others in capturing their prey. At any rate, they are more successful, but this may happen merely from their being more lively at that particular time, or more hungry. The free-swimmers have a great advantage over the fixed kinds when their food is at all scarce, and where many are present they often work near each other, as if to gain the benefit of the extensive commotion made by their joint action. This advantage is also gained by the associated colonies of Conochilus.

The student should look specially to the character and shape of the ciliary organ of the rotifer he finds. It varies from a complicated pattern in the Common Rotifer and the *Brachions* (Pilcher Rotifers), to a simple wreath in *Limnias*, and in some species disappears. In the *Floscules*, of which beautiful figures are given in Part I. of the new work, there are no cilia that give an appearance of wheel rotation, but tufts of long hairs which vibrate like the steel notes of a musical-box, without occasioning any strong wave motions. That work is left to less conspicuous organs lower down.

The chances are that hunting in small ponds where plants are growing, in gutters, amongst bits of leaves and *débris*, and especially in duck-ponds, will soon supply the observer with specimens of many characteristic species. The Common Rotifer and the Philodines, which are like her, are good swimmers by means of their so-called wheels, and they can also crawl and hold on to any object by their tail feet. The *Brachions* are free swimmers, and can anchor by means of their tail feet, but they do not crawl. These *Brachions* are the highest of the defensively-armed sorts. They are protected by shells more like

plate armour than mail, and the term *loricate* which has been given to them is scarcely appropriate. Those with no such defence have been named *illoricate*. Then come the Tube Dwellers, mostly living in gelatinous vessels like pastrycook's jars; but in the case of *Melicerta* making conical bricks of a yellow colour, and building them up into a pretty tower, widening from the base to the top.

As an aid to the study of Rotifers:—

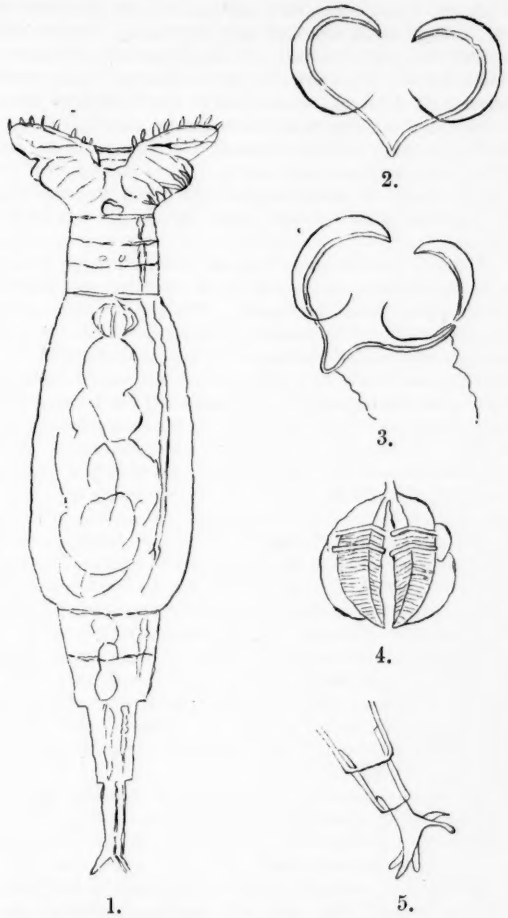


Fig. 1.—*Rotifer citrinus*, yellow Philodim, from Gosse, Tenby.
Figs. 2 and 3.—Its Ciliary wreath, vertical and side views.
Fig. 4.—Its Trophi (gizzard).
Fig. 5.—Its Tail foot.

No formal arrangement of rotifers as yet made is satisfactory, but any one of them may help the student to name a species. Dr. Hudson tries his hand at a new distribution. His *Rhizota* are those fixed in their adult stage. *Bdelloida* holds those which both swim and crawl, but they are not sufficiently leech-like to make the name appropriate. Then come *Ploïma*, which he translates as "seaworthy," suggesting, unintentionally, that they are marine. The term indicates *ship* management, and does not well fit. The last group in his scheme is called *Scirtopoda*, not a bad name for those that can skip, but he excludes most that do so, and puts only one remarkable skipper, Pedalion, in this order. It is only fair, however, to Dr. Hudson to note that he points out important correlations between the ciliary organs and the feet of his various orders, and also of their mouth structure. The ciliary organs of these creatures are very difficult to get a thorough notion of. They are usually seen, more or less, in profile, but opportunities should be sought to obtain vertical views, and for this purpose it is often convenient to use a low power and a deep eye-piece, as the greatest penetration results from this plan.

The so-called gizzard is the next organ of importance the observer should study after the ciliary wreath. It varies from complex developments, through various stages to conditions in which its resemblance to the higher forms disappears. One of the most skilful researches in microscopy will be found in papers by Gosse (Philosophical Transactions for February and March, 1855), describing and figuring no less than eighty-five distinct sets of manducatory (chewing) organs of Rotifers. Some remarks on these organs will be made in a succeeding paper. They should be studied in action, and also when freed from muscular and other matter by a drop of potash solution, which dissolves it away, and leaves the hard, glassy material, probably a form of chitin, quite clear. The *Liquor potassæ* of the chemists' shops, diluted with four or five times its bulk of water, answers the purpose.

Recurring to the new work, it should be known that Mr. Gosse and Dr. Hudson have each for many years been collectors and observers of Rotifers, and between them are able to offer a more perfect monogram than any single authority could have supplied. Mr. Gosse's skill in making beautiful and accurate drawings is too well-known to need mention, and Dr. Hudson has won distinction in the same line. Their joint labours result in a truly splendid work.

STORY OF THE MOON.*

THERE are few points in modern scientific inquiry more important or more interesting than the application of each newly recognised truth to all the varied matters on which it bears. The most striking example of this process may be found in the application of spectroscopic analysis to the heavenly bodies; only in this case it chanced that though spectroscopic analysis is in reality an optical method of pursuing chemical inquiries, it was originally (counting from the detection of the dark lines in the spectrum) suggested by astronomical research. Men inquired into the meaning of the dark lines in the solar spectrum long before they had any idea that in the spectral analysis of light they had a most effective method of chemical research. It seemed natural enough, then, in that case, to apply the principles discovered in the laboratory to the work of the astronomer in the observatory. But with many discoveries made in special lines of research this has not been the case. The workers in one field have been too busily employed to note either on the one hand the value of their results for other fields than their own, or on the other, the advantage they might obtain from employing in their own field other workers' results. In this way many important discoveries have been missed or delayed. Hence the necessity, which Spencer and others have pointed out, for scientific overseers, who, not working specially in any field, but having a general knowledge of what is going on in all,

* "The Moon: considered as a Planet, a World, and a Satellite." By James Nasmyth, C.E., and James Carpenter. (Murray: London.)

may note what the workers themselves would be apt to overlook,—the general rather than the special significance of the results obtained in the various fields of scientific labour.

In two directions results have been obtained which enable us to examine with advantage the perplexing problems presented by the surface of our neighbour planet, the moon. On the one hand, astronomical observations on bodies of a very different class—the stars—have corrected the old idea that the various orbs peopling space are probably formed of very different materials. Dr. Whewell was perhaps the last to maintain this doctrine (in his "Plurality of Worlds"), though we still occasionally hear a form of the doctrine advanced in the utterly untenable theory that in the solar system the outer planets are formed of the lighter elements, the inner planets of the heavier,—a theory inconsistent with physical and dynamical possibilities. We now see that in all probability all the orbs in space are aggregations of matter in which the various elements though not present in precisely the same proportions, are yet not very diversely represented. This doctrine applied to the moon at once defines the general nature of the problems we have to deal with, and suggests the line on which their interpretation must be sought. On the other hand, geologists have recognised the fallacies underlying their old ideas respecting the formation of the various features of the earth's surface-contour.

They no longer regard mountain ranges as portions of matter thrust upwards by the earth's interior forces, or these interior forces as products of the interior fires of the earth. On the contrary, they regard the great mountains of the earth as among the products of the exterior forces, the action of sea, rain, wind, snow, and so forth,—as resulting from processes of deposition in long, trough-like hollows, the deposited masses being eventually raised by side pressures. Again, they no longer regard mountain ranges as the oldest but rather as among the very youngest features of the earth's crust, the loftier mountains being younger generally than those of less elevation, while some of the smaller hills in certain regions are actually the wrecks of forms of elevation of which (at any rate on their old scale) no examples now remain upon the earth. Here, again, are changes of view which alter entirely the character of the problems presented by the moon's peculiarities of surface-contour, and may also serve to direct us to the proper lines of thought for their solution, as well as to new methods of observation for obtaining fresh evidence in regard to our companion planet.

We should have been glad if Mr. Nasmyth, in issuing a new and cheaper edition of his valuable work on the moon, had taken the opportunity of reviewing the somewhat crude theories of the moon's volcanic history which are associated in this volume with the finest illustrations of lunar features—craters and mountain-ranges, peaks, ravines, and valleys—ever produced. His work in this third edition is indeed as valuable as ever; but it might have been made much more valuable, if recent researches and recent results had been brought to bear upon its theoretical portions. These do not need discussion, now, however; having already been duly weighed. They are a little more out of date now than they were when the first edition appeared, but not more obviously inconsistent with the views of to-day than with those already attained twelve years ago. Apparently there has been no attempt at revision even in points of detail. For we are still told that Schmidt's map of the moon cannot probably be produced, though it has now been several years in astronomers' hands; and many little points of the same kind show that the present issue is only in the publisher's sense "a new edition."*

That the moon is or rather has been a planet there can be very little doubt, though whether she was ever a planet like our earth may be reasonably questioned. She is now so utterly unlike the earth that it becomes rather difficult to imagine that there was ever even such general resemblance as is implied in the remark that she was once a planet. She is not only arid and airless, but even were she clothed with sea and air she would yet be utterly unlike the earth because of her long day of more than four weeks. We know, however, that that is a result of terrestrial influence,—and that in the fulness of time our earth must undergo a similar change. Indeed this peculiarity, telling us as it does of the immense age of the moon, enables us more readily to understand her death-like surface. It shows us that the moon has existed long enough as a planet to have aged and died, even as we see she has.

There is no difficulty, now, in understanding that even if formed as long ago, or later, the moon would have been much older than the earth. With 81 times as much mass and only $13\frac{1}{2}$ times as large a surface, our earth would have cooled through the various stages of her life much more slowly,—in fact each stage would have lasted just as much longer as 81 exceeds $13\frac{1}{2}$, or be six times as long. Suppose the earth and moon both white-hot 60 millions of years ago, then the moon would have reached the earth's present stage 50 millions of years ago, corresponding to 300 millions of years of earth-life,—so that the moon would tell us of the earth's condition 300,000,000 years hence. And though this result is based on assumptions, it yet presents truly the general inference we may safely form that the earth will not be in the same stage of planetary life as the moon until many millions of years have passed. (If each stage of the earth's life is six times as long as the corresponding stage of the moon's, then—on any assumption whatever—the earth will only reach the moon's condition after a period five times as long as the interval which has elapsed since they were both simultaneously in the same stage, or running neck and neck in the race of planetary life.)

But even with this knowledge it remains difficult to understand why the moon should be so unlike the earth. The waters of the earth may soak their way beneath the crust (as our underground caves, and even our hot wells and volcanic outbursts, show they are doing) till they all disappear. Our air can hardly, however, become thinned to the condition of the lunar air. And even if it did, and every trace of water had vanished, the earth would not be as the moon is. There are no great craters on the earth as on the moon: there are scarcely any great mountain ranges on the moon as on the earth. In these chiefly, but in other important respects also, the moon

* Even the description of spectroscopic analysis as a method which has been brought into use "during the past few years" reads strangely in a work dated more than a quarter of a century later than the discovery by which that method was introduced, and twenty-two years later than the most recent of the spectroscopic discoveries mentioned in the book. Errors too which were noted when the first edition appeared might as well have been corrected. Amongst slight faults, more significant perhaps than important errors (which may be errors of opinion, and still maintained) we note the reproduction of a curiously absurd mistranslation of Laplace's remark that he advanced his famous nebular hypothesis "with the mistrust which everything that is not a result of observation and calculation should inspire:" this is translated as if Laplace had written *qui doit inspirer* (instead of *que doit inspirer*), "the mistrust which should inspire everything," &c.

and the earth are so unlike that the uniformitarian theory seems to fail.

But so soon as we apply to the moon the two lines of reasoning which were touched on above, we at once find reason for expecting just such differences as actually exist. Made of the same materials, proportioned probably in much the same way, the moon and the earth would have very different histories. To begin with, as we have just seen, the stages of the moon's life would be very much shorter than those of the lifetime of our earth, and therefore, even under the same conditions, the power of producing great changes of contour would be far less in the moon's case. But the conditions would not be the same. With 81 times as much matter, and presumably about 81 times as much water—spread over a surface only 13½ times as large—the earth would have had six times as much water per square mile as the moon: this would have made a great difference in the efficiency of all those forms of denuding action (and they are altogether the most important) which depend on the action of water in its various forms: it would also have greatly increased the duration of the action of these forces upon the earth, as compared with that of the action of the similar but much feebler forces on the moon. But an even more remarkable difference appears in regard to the probable density of the lunar air when she was passing through that stage of her life which corresponded with the present state of our earth's life. For, while precisely the same reasoning would apply to the air, so that the quantity over each square mile of the moon would probably have been but one-sixth of the quantity over each square mile of the earth, that smaller quantity would have been compressed only by the small force of lunar gravity, about one-sixth of terrestrial gravity. Thus the density of the lunar air would have been but one-thirty-sixth of the density of the air we breathe. Air so tenuous as this would not only be unfit to support life, it would have had very small efficiency as a denuding agent, whether we consider its direct action, or its power in conjunction with water.

On the whole, subaërial denudation on the moon must in all probability have been so exceedingly slow in its action, and the time during which it acted so exceedingly short, that the wonder is how any denudation at all can have taken place on the moon's surface. We may probably ascribe such denudation as is indicated by the condition of the crater-covered regions, and by the aspect of the mountain ranges—indeed by the very existence of any mountain ranges at all—to the time when the lunar atmosphere, like the earth's air in past ages, was laden with carbonic acid (carbon dioxide), sulphurous acid, sulphuretted hydrogen, boracic acid, and so forth. The earth's air when so constituted was immensely more dense than it is at present, and all the processes of denudation went on far more rapidly than they have done since. The lunar atmosphere at that stage of the moon's history was probably about as dense as our own atmosphere is now; but even if less dense, its constitution and its high temperature in connection with the high temperature of the crust, would lead to changes at least as rapid and effective (while they lasted) as those which have taken place on the earth since the earliest ages of which geological records remain.

Thus we should not expect to find the great craters belonging to the early stages of the moon's vulcanian history converted into such wrecks as alone attest on this earth the former existence of similar terrestrial crater-mountains. But we may yet fairly look for evidence of considerable denudation during the time, short-lasting though it may have been, when the moon's atmosphere and oceans were capable of doing effective denuding work. Accordingly we find that while the immense craters remain still the most striking features of the moon's surface, they attest the action of subaërial denudation during a period which, though it may have been short compared with the corresponding period of our earth's history, must still be measured by hundreds of thousands of years.

Now the great craters, grand though their remains are compared with the mere wrecks which (as in Mull and Skye) remain to show on our earth how large terrestrial craters once were, show yet signs of denudation. And we see in lunar mountain ranges the products of such denuding work. The great range called the Lunar Apennines attests, for example, on the moon the long-continued action of denuding forces by which the whole tract now occupied by the Sea of Serenity and the Sea of Showers was covered with matter worn by the action of sea and storm, river, rain, snow, and wind, from the surface of the lunar continents around. In a vast trough-like depression running athwart what was once the floor of an immense sea (covering both the great regions just named) the products of denudation were deposited in greater quantity than on either side. Then as the region thus heavily laden with deposited matter sank more and more deeply, the matter was collected (to the depth of many miles) out of which the future mountain range was to be formed. When at length this process ceased, and the shrinking of the moon's crust compelled this seam of sedimentary deposit to rise, forced upwards by side pressure, the range of mountains rose, rounded and dome-shaped then, but presently to be wrought into the precipitous pinnacled forms now recognised in the Lunar Apennines. The side pressures no doubt generated enormous heat, converting the sedimentary strata into various kinds of crystalline rock, the harder materials resisting best the still active denuding forces of the lunar atmosphere, and forming the higher peaks of the range as we know it now.

But we see in the evidence of such denuding action, the last important traces of subaërial denudation in the moon. Not there as on this earth have lands and seas interchanged after the manner described by Tennyson when he says—

> There rolls the deep where grew the tree;
> Oh earth what changes hast thou seen!
> There where the loud street roars, hath been
> The stillness of the central sea.
> The hills are shadows, and they flow
> From form to form, and nothing stands,
> Like mists they melt, the solid lands,
> Like clouds they shape themselves and go.

One interchange of land and water, and one only, can be recognised on the moon. The floors of the great seas tell of buried continents. The very shapes of sand-covered craters, as large as any now remaining uncovered, can be recognised—shadowy and ghost-like, but still clearly recognisable—in the broad dark tracks called seas, which doubtless are the floors of what were once great lunar oceans.

Thus do the most characteristic features of the moon's surface (except the immense ray-systems which belong to an earlier stage yet) find satisfactory interpretation in the comparative shortness of the stages of the moon's volcanian history. There are many great craters because there was not time or power to wear them down. There are few great mountain ranges because there was not time or power to fashion many. But *some* work was done in

this way; and the broad, dark sea-floors attest the energy with which for awhile such work went on, while the ghosts of craters buried beneath the sands of those lunar seas show that once, if no more, sea replaced land even in the moon.

SOAP-BUBBLES AND FILMS.*

By T. O'Conor Sloane, Ph.D.

THE true nature of a liquid film is comparable to that of a perfectly elastic and tightly-stretched membrane. All liquids are bounded and enclosed by such a membrane, composed of the substance of the liquid itself. The phenomena of films, under the form of soap-bubbles, have been known for many generations. They were seriously studied by Sir Isaac Newton, and later by the scientist Dr. Plateau, of Belgium, a curious study for one, like the latter, afflicted with total blindness.

If a ring one or two inches in diameter, and provided with a handle, is dipped into a solution adapted for forming films, and is withdrawn, it will be found to be filled with a beautiful film, straight and firm, reminding

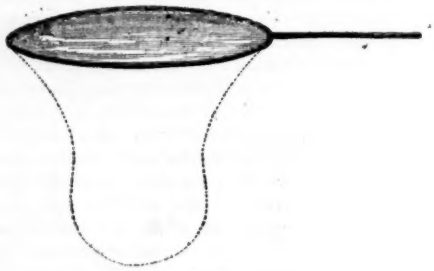


Fig. 1.

us of the wing of a dragon-fly (Fig. 1). If we blow against it, it will be driven out into a purse-like shape of very characteristic outline (see dotted line). If it be held between the mouth and a candle, it will screen the latter from strong blowing until it breaks, when the candle will be extinguished.

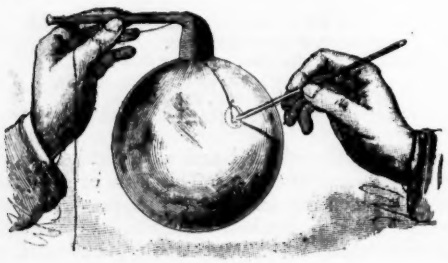


Fig. 2.

By particular management a hole of any desired size can be made in the side of a soap bubble. This is done by tying a small loop, less than the third of an inch, in the end of a silk thread, moistening it thoroughly with the solution, and hanging it over the bowl of a pipe just before blowing a bubble. As the bubble is blown, the end of the thread and the loop will adhere to it. Then by touching the film within the loop, either with a hot wire or with a piece of blotting-paper, the film will break inside of the loop, which will fly open to its widest extent (Fig. 2). The bubble will immediately collapse, or by vigorous blowing may just be kept inflated. The blast from the hole is sometimes enough to extinguish a candle.

This shows that the film is elastic. To measure directly the tension exerted by an inflated bubble, a glass tube bent at a right angle may be attached to the end of a pipe-stem. After blowing a bubble, the end of the glass

Fig. 3.

tube may be dipped into water, when the depression will show the pressure (Fig. 3). It will be but a small fraction of an inch.

To measure the tension of the film per unit of surface, a little frame with grooved sides is employed. In the grooves a wire carrying a little scale pan slides freely

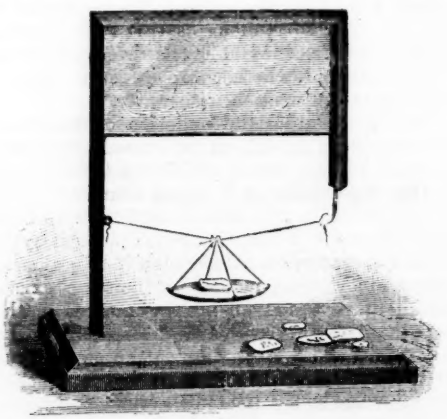


Fig. 4.

up and down (Fig. 4). The wire is pushed home to the top of the frame and some of the solution introduced, either by dipping the top or by painting it in with a brush. Then, by adding weights, the film can be pulled down like a delicate curtain until the limit is reached, and it breaks.

By mounting a ring as a pendulum and filling it with a film (Fig. 5) the retardation the latter exercises on its swing is quite striking.

Four of the rings may be mounted as a windmill (Fig. 6), and be made to turn several times by the breath until their perishable sails break one by one.

If a thread, well moistened with the solution, is laid

* From a lecture on "The Physics of Tenuity," given in full, with many additional illustrations, experiments, and formulas, in Supplement to *Scientific American*.

across a ring containing a film, and the film is broken on one side of it, the thread will be suddenly snatched across the ring and be drawn up tightly against the

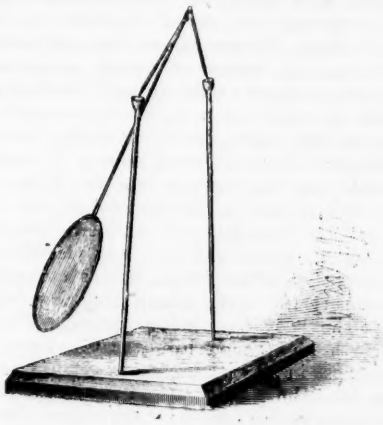


Fig. 5.

opposite side. To facilitate manipulation, the ends of the thread may be fastened to the ends of a wire, or

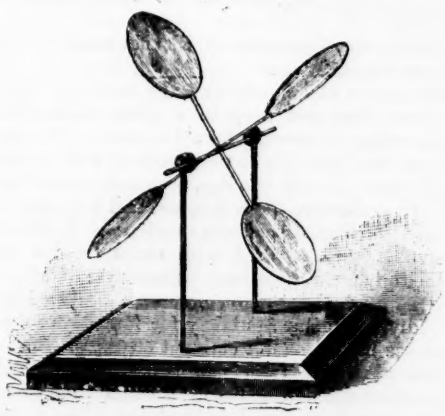


Fig. 6.

thin slip of wood. On drawing out the thread it will draw with it a curtain of film, and will assume the

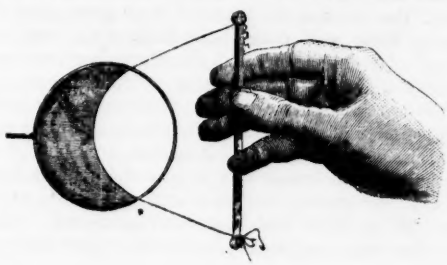


Fig. 7.

curve of the arc of a circle (Fig. 7). In this way the ring may be again filled with film and the thread be entirely removed.

A bubble may be blown, a moistened ring applied to it, and the pipe pulled away, leaving the bubble adhering to the ring. The pipe may be again dipped, passed through the upper part of the bubble into its interior, and a second bubble may be blown thus in the interior of the first (Fig. 8).

Fig. 8.

By catching a bubble on a ring, as described above, and touching it with a second ring, previously moistened, it will adhere to both, so that it can be drawn out into

Fig. 9.

the most elegant shapes (Fig. 9), reminding us of the iridescent glass vases so popular a few years ago.

Again attaching a bubble to a ring, the air in it can be drawn out by inverting the mouth of the pipe until,

Fig. 10.

on pulling away the pipe, a lenticular bubble will remain (Fig. 10).

The well-known diffusion experiment with a porous jar can be very nicely shown with a film. The mouth of

the jar, a porous cup of a Bunsen or Daniell battery, is dipped into the solution. A glass vessel full of hydrogen,

Fig. 11.

or street gas, is inverted over it (Fig. 11). The lighter gas diffusing into the porous vessel blows a bubble from the film. On removing the outer jar the reverse action takes place, and the bubble collapses.

Very pretty effects can be produced by blowing bubbles full of tobacco-smoke. By attaching the pipe stem by a rubber tube to the gas fixture, they may be inflated with gas, when they will rise like balloons. Many formulas have been published for making a good mixture. Plateau's mixture is thus prepared: one part of Marseilles soap is dissolved in forty parts of water at a moderate heat. It is filtered through very porous filter-paper after cooling, and fifteen parts of the solution are mixed with eleven of Price's glycerine. The mixture is thoroughly shaken, and is allowed to stand for seven days in a room that is not too cold (over 67° Fahr.). On the eighth day it is cooled for six hours to a temperature of 37° Fahr., and filtered. A bottle of ice should be kept in the funnel. The first portions may need refiltering. Very porous paper must be used. Halbrook's brown oil silk soap or his Gallipoli soap and Scheering and Glatz's glycerine work very well. The second filtration may be omitted, long standing and decantation from the sediment being used. After all the trouble the mixture may not give very good results.

To succeed in these experiments a little practice and niceness of manipulation are required, together with a good soap solution.

INDIAN DEATH CUSTOMS.

By Stella Occidens.

THE primitive manners and customs of the North American Indians are fast passing away, and among these, their quaint mortuary customs. This is a subject full of interest, since every nation has its own peculiar methods with regard to burial ceremonies. In a few years all trace of these will be lost, for fast-spreading civilisation will soon make these customs a matter of ancient history.

Among the North American Indian tribes, there are seven modes of burial, viz., by *inhumation;* by *embalmment;* by *deposition* of remains in urns; by surface burial (the remains being placed in hollow trees or logs, pens, or simply covered with earth, or bark, or rocks forming cairns); by *cremation;* by *aerial sepulture* (the bodies being left in lodges, houses, cabins, tents, deposited on scaffolds or trees, in boxes or canoes, supported on scaffolds or posts, or placed on the ground), and by *aquatic* burial beneath the water, or in canoes turned adrift, each tribe follows its own course, according to the established custom. The first form of burial, that is, of interment in the ground, was customary among the Mohawks of New York. Schoolcraft in his history of the Indian tribes tells us that "the Mohawks of New York made a large round hole in which the body was placed upright, or upon its haunches, after which it was covered with timber, to support the earth which they lay over, and thereby kept the body from being pressed. They then raised the earth in a round hill over it. They always dressed the corpse in all its finery, and put wampum and other things into the grave with it; and the relations suffered not grass nor any weed to grow upon the grave, and frequently visited it and made lamentation." *

The same custom prevailed among the Indians formerly inhabiting the Carolinas, but they placed the corpse in a coffin made of woven reeds or hollow canes, tied fast at both ends. After a time the body is taken up, the bones cleaned and deposited in an ossuary, called the Quiogozon.†

The Creeks and Seminoles of Florida made the graves of their dead as follows:—

"When one of the family dies the relatives bury the corpse about four feet deep in a round hole, directly under the cabin or rock where he died. The corpse is placed in the hole in a sitting posture, with a blanket wrapped about it, and the legs bent under and tied together. If a warrior, he is painted, and his pipe, ornaments, and warlike appendages are deposited with him. The grave is then covered with canes tied to a hoop round the top of the hole, then a firm layer of clay, sufficient to support the weight of a man. The relations howl loudly and mourn publicly for four days. If the deceased has been a man of eminent character, the family immediately remove from the house in which he is buried, and erect a new one, with a belief that where the bones of their dead are deposited the place is always attended by goblins and chimeras dire."‡

The custom of tying up the corpse likewise prevails among the Yumanas of South America, who "bury their dead bent double, with faces looking toward the heavenly region of the sunrise, the home of their great good deity, who they trust will take their souls with him to his dwelling. On the other hand, the Peruvian custom was to place the dead huddled up in a sitting posture, and with face turned to the west."§ With regard to burying in the ground, Tylor informs us that it is customary among the Winnebagos of North America to bury a man "sitting up to the breast in a hole in the ground, looking westward; or graves are dug east and west, and the bodies laid in them with the head eastward, with the motive that they may look towards the happy land in the west."‖

* Hist. Ind. Tribes of U.S., 1853, Pt. III., p. 193.

† First annual report of Bureau of Ethnology, 1879-80, p. 94, Smithsonian Institution.

‡ Schoolcraft, "Hist. Ind. Tribes of U.S.," 1855, Pt. V., p. 270.

§ Tylor, "Primitive Culture," vol. ii., p. 423.

‖ Ibid., p. 422, vol. ii.

Among the Otoe and Missouri tribes of Indians located in Gage county, Nebraska, it is usual to prepare the burial costume before the man for whom it is being prepared is quite dead. He is dressed in his finest clothes and ornaments, according to his own taste and directions. He tells his friends whether he wishes to have the customary sacrifices offered at his funeral or not, and they observe his commands implicitly. After he has given all his directions the women cut away part of his hair close to the scalp. The funeral shroud is composed generally of the most expensive blankets, ribbons, and beadwork. When the corpse is dressed it is placed in a recumbent position in view of all the relatives, who keep up a continual series of piercing screams and loud lamentations, expressing a grief which shows the intensity of Indian devotion and attachment. When all is in readiness, the aged men arranged in a circle round one of their number, chant a peculiar funeral dirge, keeping time upon a drum or some cooking utensil. Now and then an aged relative will get more excited than the rest, dancing excitedly, vociferating with wild gestures, tomahawk in hand, and imprecating the evil spirit, which he endeavours to drive away to the land where the sun goes down. The evil spirit being thus effectually banished, the mourning gradually subsides, blending into scenes of feasting and refreshment. The burial feast is in every respect equal in richness to its accompanying ceremonies. "All who assemble are provided with cooked venison, hog, buffalo, or beef, regular waiters distributing hot cakes soaked in grease and coffee or water as the case may be." After the feasting is over the corpse is placed in a waggon and propped up in a sitting position, with friends on each side; or else it is bound on a horse, and "thus conveyed to its last resting-place among his friends." In this same waggon all the goods and chattels of the deceased are placed, which are unloaded at the burial place, and arranged in the vault-like tomb, after which the corpse is laid in the grave. "The bottom which is wider than the top (graves here being dug like an inverted funnel), is spread with straw or grass matting, woven generally by the Indian women of the tribe, or some near neighbour. The sides are then carefully hung with handsome shawls or blankets, and trunks, with domestic articles, pottery, &c., of less importance, are generally piled around in abundance. The sacrifices are next inaugurated. A pony, first designated by the dying Indian, is led aside and strangled by men hanging to either end of a rope. Sometimes, but not always, a dog is likewise strangled, the heads of both animals being subsequently laid upon the Indian's grave. The body, which is now placed in a plain coffin, is lowered into the grave, and if a coffin is used the friends take their parting look at the deceased before closing it at the grave. After lowering a saddle, bridle, blankets, dishes, &c., the mourning ceases and the Indians prepare to close the grave." Among the Otoe and Missouri Indians dirt is not thrown in upon the body, but simply rounded up from the surface upon stout logs that are accurately fitted over the opening of the grave. After the funeral ceremony is completed all the property of the deceased, from a tent and horses to the merest trifle, are distributed among the relatives, whilst wife, children, or father are left without anything. A midnight vigil is carefully kept by these Indians four days and nights at the graves of their departed. "A small fire is kindled for the purpose near the grave at sunset, where the nearest relatives convene and maintain a continuous lamentation till the morning dawns. There was an ancient tradition that at the expiration of this time the Indian arose, and mounting his spirit-pony, galloped off to the happy hunting-ground beyond."*

Formerly, when a Greenlander died his property was regarded as having no owner, unless he had grown-up children, and every one took what he could get, whilst the wretched widow or children were left out-door pensioners. In Vanua Levu, one of the Fiji Islands, a chief's death "is the signal for plunder, the nearest relations rushing to the house to appropriate all they can seize belonging to those who lived there with the deceased."†

(To be continued.)

WASPS AND HORNTAILS.

By E. A. Butler.

Of our seven British species of *Vespa*, the hornet stands by itself, both as regards size and colour, and may be conveniently left till we have considered the remaining six, which are more or less alike, and consist of three that form their nests underground and three that build in trees. The latter are *V. sylvestris*, *arborea*, and *norvegica*. The second of these we need not trouble ourselves about, as it is a rare insect, and not at all likely to be met with. *Norvegica* occurs principally in the north of our island, being fairly common in Scotland; and *sylvestris*, while generally distributed, is yet not so common as the ground builders.

The latter are *V. vulgaris*, the so-called "common wasp" (not that it is always the commonest, though often so), *germanica*, and *rufa*, and it is the two former of these that are most likely to fly in at our open windows and manifest a disposition to join us in our meals. On one occasion a large number of females of *germanica* were found gregariously hibernating in an upper room of a large building that was used for storing furniture. Some were amongst some blankets used in covering the furniture, and others were clinging to some rough woodwork, into which, as with a consciousness that their limbs would become benumbed and useless during the winter, they had firmly dug their mandibles. To give an idea of the proportionate distribution of these species, I may mention that a friend of mine in the south of England, last summer, on examining sixty wasps that had been captured quite promiscuously in his garden, found them to consist of twenty-four *germanica*, fourteen *vulgaris*, seventeen *rufa*, and five *sylvestris*. This, however, probably represents an unusually large proportion of *rufa*.

For the distinctions of these six yellow and black species, we must look mainly at the face and the first segment of the abdomen. Turning first to the former of these, we examine carefully the central plate referred to in our last paper—viz., the clypeus—and are at once struck by differences here; in all the clypeus itself is yellow, but the black markings upon it vary (Fig. 1). *Vulgaris* and *rufa* carry on the clypeus a vertical black stripe, descending, in the workers, from the centre of its upper

* Account given by Dr. W. C. Boteler, physician to the Otoe Indian agency, Gage county, Nebraska, published in first annual report, Bureau of Ethnology, p. 96, Smithsonian Institution.

† Sir J. Lubbock, "Origin of Civilisation," p. 447.

edge to the centre of the lower, and more or less dilated near the lower extremity into two lateral projections; in the males and females, the mark usually does not quite reach the lower margin of the clypeus, but terminates at these projections, and it thus acquires something of the appearance of a cheese-cutter with a long and stout handle. It has also been likened, with less justice, to an anchor, and hence both these species are sometimes called anchor-faced wasps. *Norvegica* also carries the anchor-mark on its clypeus; so that there are three species adorned in this way, two ground-wasps and one arboreal species.

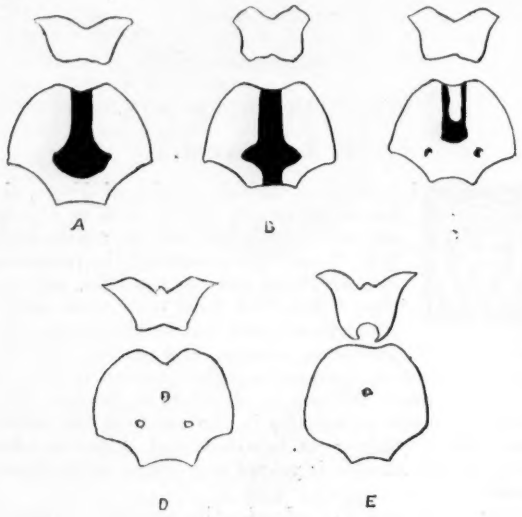


Fig. 1.—Coronet-spots and clypei of wasps. A, *V. vulgaris*, female; B, *vulgaris*, worker; C, *germanica*, worker; D, *germanica*, female; E, *sylvestris*, worker.

Germanica, on the other hand, carries, in the workers, a central black stripe, stretching only part of the way down the clypeus, and often more or less imperfect, and two black dots placed triangularly with the free end of the stripe. In the males and females, there are usually simply three black dots placed triangularly, without a black stripe at all. Lastly, *sylvestris* has only a single black dot in the centre of the clypeus, or, in the females, often no black markings at all.

Turning now to the basal segment of the abdomen, we find that *rufa* has some rusty stains around the black spots there, in addition to the yellow band which occupies the greater part of the segment, and the same rusty hue often occurs on other segments as well; it is from this peculiarity that the species derives its name (*rufa* = red). But it would not be safe to conclude that any anchor-faced, red spotted wasp is *rufa*, since *norvegica* is usually similarly coloured; the red colour, however, will serve to distinguish *rufa* from *vulgaris*, both of which, it will be remembered, are anchor-faced.

The basal segment of *germanica* carries three large and distinct black spots in its yellow band, the centre one of which is diamond-shaped; *vulgaris*, instead of this diamond, has simply an angular indentation. But these two species are sometimes very difficult to separate, especially the workers, since the markings on the abdomen vary a good deal, and even those on the face are not quite constant. *Sylvestris* is sufficiently separated from the rest by its single clypeal spot.

We still need a reliable means of separating *norvegica* from *rufa*; this is to be found in the compound eyes, which, in the latter species, are continued to the base of the jaws, but in the former do not extend so far. *Sylvestris* agrees with *norvegica* in this respect. We may add to these distinctions, that while the ground-wasps have a yellow stripe on the scape of the antennæ only in the males, the tree-wasps have it in all sexes. As if, however, to prevent the use of this as a reliable diagnostic character, the female of *rufa* sometimes takes on a yellow stripe. The coronet-shaped spot, too, varies in the different species, but not in such a way as to be rendered easily intelligible in words, and the above distinctions will, in most cases, suffice for the determination of the species.

Few people seem to be familiar with the hornet, except by name, and two totally different insects are commonly mistaken for it. One of these is a large Dipterous, or two-winged, insect, the largest *fly* we have in this country. It is a robust, black and yellow creature, called *Asilus crabroniformis*, the specific name, which means "hornet-like," being given in allusion to the above error, *crabro* being the Latin name for a hornet. It is a common insect in the summer time in many places (not indoors, however), and dashes about with bold and vigorous flight and great buzzing, and with so martial an air that it is not surprising that those who do not know its real nature should be intimidated by it. It is, however, a perfectly harmless creature.

The other insect sometimes mistaken for a hornet comes a little nearer the mark, for it *is* hymenopterous; but still it does not belong to that section of the order which contains the wasps and other stinging insects. It is closely related to the group of saw-flies, and is one of the largest hymenopterous insects we possess. It is a yellow and black powerfully-flying creature called *Sirex gigas* (the specific name is given in allusion to its *gigantic* size), and the female, which is the sex most often seen, possesses a long and stout ovipositor, which looks dangerous enough, though it is simply a kind of auger, and not a poisonous weapon at all, so that the insect, though so formidable in appearance, is in reality harmless. This great ovipositor has acquired for its possessor the name of "Horn-tail."

Both the above insects are yellow and *black*, and, as we have already seen, the latter colour forms no part of the ornamentation of a hornet; moreover, when one comes to look at them closely, they are at once seen to be altogether unlike wasps, though, of course, when they are on the wing, and dashing rapidly about, it is not so easy to see this. Now the hornet, the scientific name for which is *Vespa crabo—i.e.*, reversing the order of the words, the "hornet wasp,"—is in shape exactly like an overgrown wasp; so that its form must be familiar to every one. We have only to imagine the yellow of the wasp's body to be deepened in tone, the black to be replaced by brown, and the whole insect to be considerably magnified, and the wasp becomes a hornet. If this be borne in mind, there should be no difficulty whatever in recognising a hornet, for there is no other British insect to which the description will apply. Since the *Sirex* is not unfrequently found in houses, as well as the hornet, it is all the more necessary to be able to distinguish the harmless insect from the dangerous one. The hornet's wings, like those of a wasp, are covered with a profusion of tiny hairs, which, however, are so small as to be quite invisible without the aid of a microscope.

The hornet constructs its nest of a material prepared similarly to that used by the rest of the genus, but it is

of a coarser texture, and inclines to a yellowish brown, instead of the delicate grey of the smaller species. As an instance of the rapidity with which these insects work, the following particulars, given by Mr. R. S. Standen, concerning a hornet's nest found, in the summer of 1881, in a shed in Norfolk, may be quoted. It was constructed in a thin shell of mortar about the size of a lemon, and open at one end. It was commenced on June 24, and the writer goes on to say:—"Although when I first observed her (the queen hornet), the shell was perfectly empty, by the morning of the 28th—less than five days—she had constructed twenty-six cells; two were empty, seventeen contained eggs, five had good-sized larvæ, and the remaining two were already sealed up for the pupa stage." Prudential considerations at this moment suggested the advisability of putting a stop to the further development of this interesting colony, lest battle might have to be done against scores of winged warriors, instead of one solitary heroine; and the whole colony, together with its foundress, were accordingly massacred. Many other instances are on record of the occurrence of hornets' nests in sheds, lofts, and thatched roofs.

The *Sirex* mentioned above may now come in for a somewhat more detailed notice. It occasionally occurs in houses in the same way as the large longicorn beetles referred to in a previous paper; it is a wood-borer, and attacks fir-wood chiefly, and its larvæ and pupæ are therefore sometimes present in the timber used in the construction of houses; and, enclosed in this, the immature insect may be introduced into the edifice, the completion of its metamorphosis being delayed till after the timber has been placed in position, when it emerges, to find itself, not amidst its native pines, but an uninvited guest in society to which, on account of its size, its appearance, and its loud buzzing, it is often an object of unnecessary terror. Sometimes it does not issue from the wood for a considerable time, which may occasionally amount to years; amongst other instances, there is a record of the emergence of several specimens from the floor of a nursery in a house that had been built for three years, and where, very naturally, they caused quite a fright to the children who were its occupants. Usually they occur in houses either singly, or at most in twos or threes, but sometimes considerable numbers have been met with; for instance, in the summer of 1878, no less than a dozen specimens were captured in an ironmonger's shop in Chichester. It is obvious that in many cases these household specimens may not really be British at all, but, if the timber be foreign, may have been imported with it.

The female of *Sirex gigas* (Fig. 2) has a black head and thorax, and a long cylindrical yellow abdomen, with a broad black band, like a mourning band, across the middle. Behind the eyes, which are not situated on the bend of the head, as they are in wasps, are also two yellow patches, which are so conspicuous and shining, that they might very probably at first sight be mistaken for the eyes themselves. The antennæ and legs are long and yellow, and the former are proportionately much longer than in the wasps, since they consist usually of about twice as many joints. The four large membranous wings are shining and transparent, though strongly tinged with yellow, and are without the minute hairs that cover those of wasps. When the wings are fully spread, the insect may measure as much as two inches across, but specimens are often found much smaller than this; like all wood-feeding insects, they vary greatly in size. The abdomen is attached to the thorax by the whole of its base, instead of the slender peduncle that constitutes the familiar and proverbial wasp's waist.

But the most interesting part of the insect is the ovipositor, which consists of three parts, two yellow side-sheaths, which are toothed outwardly towards the extremity, and a black central borer, which is notched at the end, and is therefore able to act something like a gimlet. This instrument runs up underneath the abdomen, and has its origin more than half way up the latter; it also projects beyond the abdomen to about the same extent, and measures almost an inch in total length. In addition to this, the last segment of the abdomen is produced above into a long and stout spine, which is nearly half as long as the free part of the ovipositor. With the ovipositor the mother pierces the bark of the tree she has chosen for the support of her progeny, in order that she may deposit her eggs in such positions as shall place the young grubs in circumstances of comfort and opulence from the moment they first see the light.

Her consort is altogether a slenderer, smaller insect, and has a reddish body, without the mourning band—and, of course, without the formidable boring apparatus; all he can show in the way of offensive or defensive weapons is a very sharp point at the end of the last segment of his abdomen, in the same position as the much larger spine of his spouse.

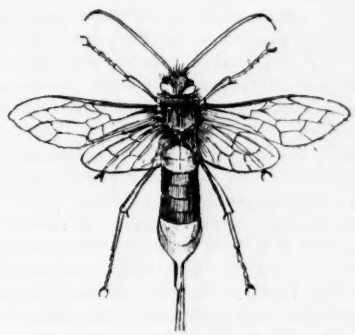


Fig. 2.—Sirex gigas (female), natural size.

Sirex gigas is sufficiently large to show with tolerable ease a certain structure in the wings which is eminently characteristic of the Hymenoptera, though often too small to be readily seen. When spread out, the fore and hind wing on each side will be found to be in some mysterious way connected, so as to move in concert, and to offer, over the greater part of their area, one unbroken resisting surface to the air. If, however, they are waved about in various directions, they may at length be caused to spring apart, and then, if the front edge of the hind wing be held towards the light, the explanation of the mysterious union will be found. Here will be seen, running part of the way along the margin, a row of between fifty and sixty tiny hooks, bent upwards and backwards in such a way that when the wing is brought into position behind its fellow, they clasp from underneath the stout nervure which bounds the forewing on its hinder edge, and thus hook the two wings together. In the centre they are placed much more thickly than at the ends, and show a tendency to form two distinct rows. It is obvious that this arrangement greatly increases the power of the wings, and no doubt largely contributes towards that vigour of flight which is so prominent a feature in the Hymenoptera.

The larvæ are fat, whitish maggots, with six very tiny

feet in front, and the tail ending in a spine, and, from their size, it will be easily understood that they work great havoc in fir-trees in which they have established themselves, devouring, as they do, the solid timber. When the insect reaches the end of its larval life, it forms a silken cocoon in its burrow, and in this changes to a pupa, which, as is customarily the case amongst the Hymenoptera, looks like a mummy of the perfect insect. In this same burrow it enters on its perfect life by casting its pupal skin; but, when thus freed, it has still to make its way into the open air; its burrow has already been carried as far as the bark of the tree, and it therefore has now to perforate the bark in order to escape from its prison. This it does by gnawing through it, and then creeping through the opening thus made. It often recruits its strength after its exertions by sitting on the tree-trunk just outside for a time, before starting on its noisy flight.

When domiciled with man, however, its escape from its prison-house is not always so easy. At a military clothing-store in France, one of the shelves on which the clothes were piled contained a pair of *Sirices*, presumably in the larval condition when first introduced. On arriving at maturity, the insects proceeded to work their way out of the wood as usual, but when they reached the surface, they found their further progress barred by the piles of clothing, which happened to consist of a number of pairs of woollen trousers. Nothing daunted, however, they set to work upon these also, and pierced them in several directions, as they had previously done the wood, until at last they reached daylight, when, as a rather disappointing reward for their perseverance, they fell into the hands of one of the officers, who was himself an entomologist.

Like one of the longicorn beetles before alluded to, this insect has sufficient strength and perseverance not to be hindered in its burrowing operations, even by so formidable an obstacle as sheet lead—or, indeed, by a still thicker layer of the same metal. Two instances of this have been reported to the Entomological Society of France by M. Lucas. In one instance it was a lead-covered roof that was perforated, the lead being about one-eighth of an inch in thickness. The other was a very curious case. It occurred in an arsenal at Grenoble. A box of cartridges was discovered in which some of the bullets had been pierced by these insects, the explanation apparently being that the larvæ had been in the wood of which the box was composed, and that the perfect insects, in endeavouring to work their way out, had directed their course inwards instead of outwards, and had thus encountered the cartridges, through which they had been compelled to eat their way; some of them, however, had perished in the attempt, and they were found dead in the box, with their beautiful yellow bodies blackened with the lead and powder.

There is an allied species, called *S. juvencus*, in which the female has a shorter ovipositor, and is entirely of a splendid steel blue colour. This also occurs in houses, similarly to *S. gigas*, which it equals in destructiveness as well as in size. Some years ago, no less than two hundred fir-trees were destroyed by this insect on a large estate in Norfolk. It seems probable, however, that the *Sirex* must not be charged altogether with this wholesale destruction; the insects appear to have a tendency to attack trees that are already enfeebled by disease or damage, instead of those that are vigorous and healthy, and, therefore, perhaps in some cases they merely accelerate a death which could not have been long delayed. Still, of course, when they do attack a tree, they often utterly spoil the wood as timber, by their numerous burrows in all directions. As an instance of this, we may take a tree that was found in Bewdley Forest some years ago. Twenty feet of the length of this tree was so perforated by this insect as to be completely useless as timber, and serviceable for nothing but firewood. It was transferred to an outhouse, and while lying there for some months, the insects emerged from their burrows at the rate of some five or six a day. It is curious to note that the first specimens hatched were chiefly males, but, as time went on, the females became more numerous and the males less so, till at last only females appeared.

(To be continued.)

THE EARTH'S PAST.

By Richard A. Proctor.

THE earth's surface has long been recognised as presenting a stupendously difficult series of problems — problems indeed which can never be fully solved. So soon as men gave up the old idea that the crust had been fashioned originally much as it is now—so soon as, turning over the leaves of the great earth-volume, they began to read what is recorded there, they found, in the first place, that the record runs back over millions of past years, and in the second place, that it is full of gaps, of blurred pages, of scarce interpretable passages. Yet imperfect though the record is in many places, and hard to read in others, it at least tells us clearly the general history of the earth from the time when first there were lands and seas in her surface as now, and when the rival forces of denudation on the one hand and of land-making on the other began the contest which has continued for millions of years in the past, and will last for millions of years yet to come.

We no longer, indeed, look back over such a uniform series of changes as the earlier students of geology contemplated. We no longer regard the layers of the earth as comparable with those of an onion, or formed in uniform succession as to time. We see, for example, that even as, in our own age, the denuding forces are forming new strata out of the materials of Quaternary rocks here, out of Tertiary rocks there, of Cretaceous, Jurassic, and Triassic rocks elsewhere, and in other vast regions, even out of the Primary rocks down to the Lower Silurian and Cambrian, nay even to the Archæan rocks themselves, so it has been all the time. The crust of the earth has never presented features purely Pleistocene, or Pliocene, or Miocene, or Eocene—or presented, indeed, any uniform aspect at all; and as the formations have never been uniformly presented, so also the strata have never been uniformly laid down. We can no more say the earth was at one time carboniferous and at another cretaceous, than we can say that the soil of England was in such and such an era waste, at another time pasture land, at another crop land.

Yet we can look back over the past history of the earth and recognise her constant, though not uniform, progression from her Archæan condition to her present state.

The problems thus presented by the earth's history, while stupendously difficult in detail, are yet so far soluble that we can find in the action of air and water on the one hand, and subterranean forces on the other, the explanation of the general progression of the earth to

her present condition. It is otherwise with those prior changes by which the earth passed to the stage when she was fit to be the abode of living creatures. We have evidence, indeed, here also, but it is not so close at hand. We have knowledge of the chemical and physical laws involved in the problem, but the conditions under which the processes then taking place proceeded were unlike any under which we can now experiment. So far as I know, the problems suggested by the consideration of the earth's fiery youth have not been as yet very closely dealt with. Let us note some of the evidence, and some of the points which may fairly be regarded as clear.

In the first place, I think we are too apt to regard a planet in its fiery youth as more uniform than the earth is as we recognise it now. We find the idea common that there would be a molten mass, with perhaps a solid nucleus and a solid crust, and outside that, a complex atmospheric envelope, high up in which would be suspended immense layers of cloud, enshrouding the real planet from outside view. These ideas seem as likely to be erroneous as the common idea of the earth as enclosed in a uniform series of strata before wind, rain, and storm cut her surface up into mountains and valleys, hills and dales, ravines and gorges. Probably the structure of the earth, when in its fiery youth, was even very much more complex than the contour of the earth's crust is now. All the conditions favoured tremendous disturbances. The upheavals and down-sinkings of the crust, for instance, would be very much more active then than now, though it does not follow that the resulting inequalities of level would be greater. Indeed, they would not be nearly so great, for the simple reason that, whatever the actual materials of the forming crust in those times, the intense heat pervading it would suffice to render it too unstable to be able to stand out to very great heights above the mean level. But consider how rapidly it would be changed by the subaerial forces which in those days must have been at work.

On our present earth we have an atmosphere of oxygen and nitrogen producing a pressure of about 15 lb. to the square inch; water is from time to time added to it in the form of vapour raised by the sun's heat from the sea, and it is this water, forming into clouds, and pouring down on the land, which leads to all the denuding work of river, cataract, rain, snow, ice, and glacier. In addition, there is the direct denuding action of the air in wind and storm, the direct denuding action of water as the waves of the sea pulsate on their shore-lines.

But such denuding forces can be absolutely as nothing compared with the denuding forces which must have been in operation when the earth was young. It is certain that the oxygen and nitrogen now present in the air are but a residuum of what was once there. But besides these gases, now in due proportion for the support of the earth's life, there were immense quantities of carbonic acid gas, of sulphurous acid, sulphuretted hydrogen, chlorine, boracic acid, and other destructive gases, some ready to assume the liquid form, and so to be still more destructive. But there would also be immense quantities—whole oceans one may say—of water in the form of vapour. The pressure of that primeval atmosphere would have been so great that the waters of such oceans as would have existed then would not have turned into steam save at a temperature so far above the boiling point at the present atmospheric pressure, that the surface of the ocean would actually have glowed with inherent lustre. The water-vapour in the air would have been no such cool and pleasant vapour as now exists in our air, but steam at high pressure and intensely hot. The rains falling then would have been torrents of hot water, impregnated with destructive acids, and falling on intensely heated rocks, ready to respond with intense rapidity to the destructive influences of those falling torrents, and of the dense, complicated, and destructive atmosphere through which they fell. We may be well assured that the changes taking place in the aspect of the earth's surface during that remote part of her career were far more rapid than those taking place now.—*Newcastle Weekly Chronicle.*

ELECTRICITY AT HOME.

By W. Slingo.

EXPERIMENTS WITH AN ELECTRIC MACHINE.

THE various parts of the electric machine constructed on the plan detailed in my previous article require some little care in fitting together, and no pains should be spared to ensure this being done as perfectly as possible. The great feature, of course, is that the framework should form a rigid structure, and one that is not likely to fail in any part. If one of the uprights affords a firmer fit than the other, it should be selected as the one which is to be nearest the handle, and it is also this one that should be cut across at the bearings (as in Fig. 3, p. 25). Presuming the experimentalist is right-handed, so that he would be best able to revolve the cylinder from him, that is, by moving the handle in a similar direction to that taken by a watch-hand, then the rubber and its support should be placed on the side of the base nearest him, and necessarily the prime conductor should be placed on the opposite side.

Before attempting the production of electricity, the leather surface of the rubber should be coated with amalgam. A small piece or strip of tin-foil should connect the amalgam with the foil coating on the cylinder. The silk rubber should be laid over the amalgam—a method which will be found preferable to that of coating the rubbing surface of the silk directly.

It is essential for the production of any quantity of electricity that there should be a complete "circuit," or path, for the electricity to travel; from the rubber to the prime conductor (by way of the moving cylinder) thence back again directly or indirectly to the rubber.* More often than not, the earth forms a part of the "external" circuit (that portion external to the machine itself). Should we wish to collect a charge, or secure a series of flashes or sparks, we shall find that in most cases it will best suit our convenience to connect either the rubber or the prime conductor direct "to earth," or to some other conductor connected therewith. In many machines the rubber is made in electrical connection with the framework, whereby a more or less perfect earth is "made," by way of the table, floor, &c.

By providing the rubber as well as the prime conductor with an insulating support, we are, however, able to secure a charge of positive or negative electricity at will.

* It is to be observed here that, although I speak of the electricity travelling from the rubber to the prime conductor, I only use this way of expressing the phenomenon in question because it is the simplest mode of dealing with it. To enter into the question fully would occupy several pages, and for those who are sufficiently interested in the controversy there are many works on the subject available.

XUM

For the purpose of making the connections, procure a couple of copper or brass washers (like those used in making the handle) about five-eighths or half an inch in diameter, and furnish it with a hole (A, Fig. 1) about an eighth of an inch in diameter. Drill two other holes, B C, large enough to allow stout brass pins (or nails) to pass through. Round off, with a file, any asperities, and then pin one of the pieces of metal on the wooden cylinder carrying the rubber, placing it in the centre of the outer side or that side remote from the glass. A gimlet or bradawl should next be used to make a hole in the wood corresponding with the hole A (in Fig. 1). Into this hole drive lightly a short brass-headed nail (such as is frequently used for hanging pictures). It would be an improvement to sink the brass washer or collar into the wood by making a shallow hole therein with a brace and centre or twist bit of the necessary size. If the washer fails to make contact with the foil coating of the wooden cylinder, a piece of tin-foil should be pasted on so as to preserve the electric continuity.

Fig. 1.

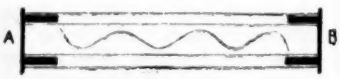


Fig. 2.

Fig. 3.

The other washer should be similarly fixed on the outer side of the prime conductor, and should be likewise furnished with some such article as a brass-headed nail for connecting purposes. The nail should not, however, be fitted tightly, as it will often be found advantageous to remove it and substitute a piece of stout iron or other wire, provided at one end with a metallic or metal-coated ball. A very efficient substitute for a metal ball is a wooden one, painted with gold-size and rolled over a Dutch metal leaf until it is fairly covered.

The machine being now fully equipped, warm it thoroughly before a clear fire in a room free from draught, as a moist atmosphere is fatal to experiments with an electric machine. Then procure a piece of wire, eighteen to twenty-four inches long, thickly coated with gutta-percha. Failing this, attach one end of a piece of bare wire to the rubber-cylinder, and warm over the wire, at about six inches from the other end, an ordinary stick of sealing-wax, to serve as an insulating handle. Bend the free end into a ring, or fasten it to a conducting ball, such as a brass ball or even a rounded piece of apple or potato. Bring this, while the machine is being turned, near enough to the prime conductor to enable sparks to pass, and copious and brilliant discharges can be observed.

Similar, but possibly not always such satisfactory, results can be obtained by connecting the rubber with a gas or water-pipe, or some other conductor, reaching to the earth, and then bringing an earth-connected rod near the prime conductor. These two experiments, be it observed, are identical in principle. A very interesting and somewhat striking experiment is illustrated in Fig. 2, where a piece of glass tubing, half an inch in diameter and ten or twelve inches long, has pasted round it in spiral form a series of small diamond-shaped pieces of tinfoil, placed about an eighth or quarter of an inch apart. Over one end is fixed, by means of cement—say, plaster of Paris—a brass cap (Fig. 3), consisting of a piece of brass tubing half to three-quarters of an inch long, soldered to a circular piece of this sheet-metal, three-eighths to half an inch larger in diameter than the brass tubing. Then is fitted loosely over the outside of this brass tubing another piece of glass tubing of the same length as the smaller tube. Finally, another cap, similar to Fig 3, is fitted on the free end of the apparatus. The object of the outer glass tube is twofold. In the first place, it protects the pieces of tinfoil; and, in the second place, it facilitates the operation of rotating the inner tube with one hand while the outer tube is clasped in the other hand. To work the apparatus, hold one of the conducting knobs in the hand (or by some other means make an earth connection), and place the other knob near the prime conductor. On the machine being turned, numberless sparks will dart across between the pieces of foil, the attractiveness of the effect being greatly enhanced by revolving the tube.

The tube may be made to revolve automatically at the cost of a little more care and labour. The apparatus is illustrated in Fig. 4. For this a separated insulating stand may be used, or a small hole may be bored in the top of the prime conductor.* Into this fit a short piece—say, three-quarters of an inch long—of iron (the diameter being such as to fit the hole loosely). To the upper end of the rod solder a round piece of thin sheet brass about an inch

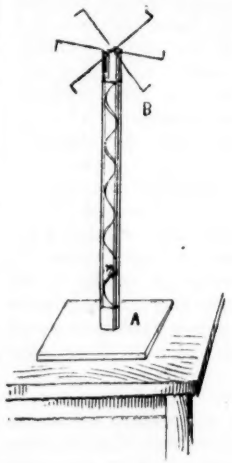


Fig. 4.

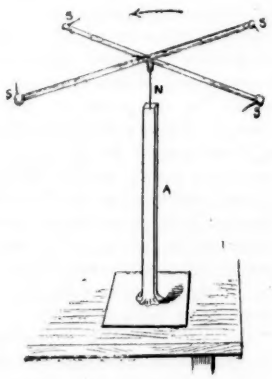


Fig. 5.

in diameter, and having soldered to its upper surface a piece of brass tubing three-quarters of an inch long and large enough to fit the outer glass tube of the spiral fairly well (either inside or outside). The inner tube is provided at the bottom with a pivot, which may consist of a short pointed piece of steel attached to a wooden plug fitting inside the tube. A hole should be drilled through the brass disc large enough to allow the pivot to rotate freely, the point working on the smooth end of the subjacent iron. The lowest piece of foil on the tube should be connected electrically with the pivot.

The upper end of the inner tube should be fitted with a cap, consisting of a piece of brass tubing surmounted by a round piece of thin sheet brass, the brass tubing extending for an inch or so above the outer glass tube. On to the cap solder a number (three or four) of thin wires about eight inches long, and with about half an inch at each end bent horizontally and at right angles, all the bent portions, or "points," pointing in one direction (as viewed in walking round a concentric circle). The parts should all be as light as possible, and should balance well. If the apparatus thus made be put

* It would be advantageous to let in, in this case, a piece of a small brass tubing having an internal diameter of three-sixteenths or a quarter of an inch. It would in some instances prevent damage being done to the cylinder.

together, and placed on the prime conductor, electricity will, when the machine is worked, pass up the spiral, and so to the points, where, on escaping, it produces a perceptible wind, having sufficient force to drive the "electric mill" round in the opposite direction to that of the points.

A simple form of electric mill may be made by sticking a needle, eye downwards (N, Fig. 5), into the end of a dry wooden rod or a stick of sealing-wax (A), and balancing on the point, the moving portion consisting of two or three straws (S S), about eight inches long, stuck together at their centres with sealing-wax, and furnished with fine wires passing through the straws, and bent at their extremities so as to produce the "points," all of which should be turned in the same direction. A small piece of straw or a fine glass cone (made by heating a piece of glass tubing, drawing it out, and cutting the part off for the cone) being fastened to the junction of the straws by means of sealing-wax completes the apparatus, which may be worked from the table by connecting the needle with the prime conductor, and turning the machine.

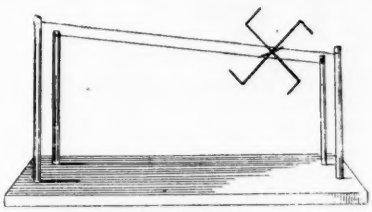


Fig. 6.

In Fig. 6 is illustrated another simple piece of apparatus dealing with the effect of points. A wooden base measuring about nine inches by five is provided, and is fitted at one end with glass rods a quarter of an inch in diameter and about eight inches long, the other end being fitted with similar rods five or six inches long. Straightened pieces of wire are attached to the upper ends of the rods as shown in the diagram either by being soldered to brass caps fitted on to the glass, or they may be simply stuck on with a little sealing-wax. A third and very efficient mode of fixing is to fit paper tubes three-quarters of an inch long over the tops of the rods, and passing the wires through holes made for the purpose in the sides of the tubes (about half their length being left about the rods), to fill up with a cement composed of equal parts of powdered resin and beeswax melted together and mixed with a somewhat larger proportion of red ochre. The next thing is to make the mill, which should consist of four pieces of thin wire, each three and a half inches long and bent at the ends at right angles (as shown). A small thin metal disc drilled at the centre should be fitted to a piece of wire stout enough to form the spindle, and the bent pieces soldered to its sides, as little solder as possible being used, and care being taken to keep the mill as nearly balanced as possible. The mill being placed on the lower ends of the inclined wires, and these wires connected with the prime conductor, the discharge of electricity from the points will cause the mill to revolve, and in so doing to ascend the inclined plane. Obviously the mill must be placed on the wires with the points in the direction shown in the diagram.

A sheet of note-paper may be made to yield both interest and instruction. To the knob (*c*, Fig. 7), on the wire attached to the prime conductor (or to the conductor itself) attach a stout wire of any convenient metal, bent to the shape shown, the end B being turned up so as to form a hook. Over this hang a sheet of foreign note or tissue paper cut into narrow strips. On turning the machine, the strips fly apart by mutual repulsion. If the hand be brought near attraction towards it results;

Fig. 7.

the same is observed if a needle be approached (sideways), so long as it is covered by the finger, but if the finger be withdrawn, the strips will be blown away, although if the needle be held upright under the hook, so as to be opposite the centre of the tassel, discharge ensues, and the strips fall together (as in Fig 8).

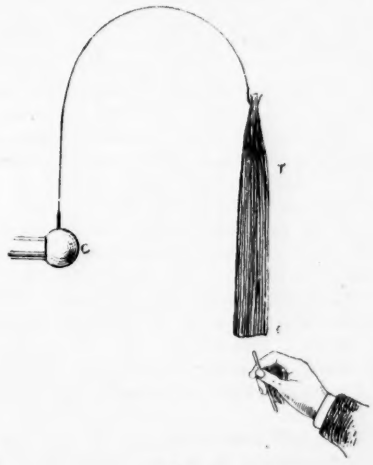


Fig. 8.

The principle involved in this experiment is a highly interesting one and, properly understood, is capable of rendering intelligible many of the apparently more intricate experiments and many of the phenomena pertaining to atmospheric electricity. To some of these latter our attention will next be directed.

A highly interesting and simply constructed piece of apparatus is that illustrated in Fig. 9, where A B is a piece of stout wire, eight or nine inches long, provided at its ends with small conducting balls, either of metal or of wood, &c., coated with Dutch metal or tin foil. From the ends two-inch bells, C, D, are suspended by

short lengths, say four inches, of common brass chain, and from the centre a similar bell, E, is suspended by means of a piece of silk thread equal in length to the chains. From E a third chain hangs and is connected with some conductor in contact with the earth or with the rubber of the machine. F, G, are two small conducting balls, about half an inch in diameter, suspended by silk thread, and normally hanging midway between the bells. A hook, made by bending a piece of moderately-stout wire, is soldered on to the centre of the suspension-rod, and is intended to be placed over the rod in con-

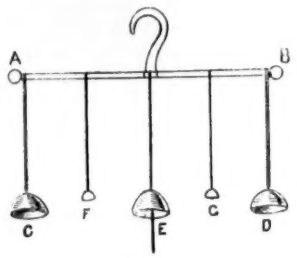


Fig. 9.

nection with the prime conductor. On the conductor becoming charged, the balls will be seen to oscillate between the bells, striking them in turn. The *rationale* is not far to seek if we remember that the charge on the conductor (to which the outside bells are electrically connected) is very large in comparison with the capacity of the balls. Supposing the ball F to be inductively electrified, and consequently attracted by the ball C, it will come into contact with that bell, and will at the same instant become similarly charged and necessarily repelled. But being repelled from the similarly charged bell, it is also attracted by the earth-connected and so-called neutral bell E, on coming into contact with which the ball loses its charge, and would then fall back into the vertical position. This, however, it is prevented doing in virtue of the attraction, which is again exerted between it and the bell C. In this way the oscillation of F is maintained so long as any charge remains in C. The ball G is actuated by precisely similar influences, the bell D being in the same electrical condition as C. Were there a given charge imparted to the conductor, and the bells C, D, then F, G, would act as small carriers, and would in time dissipate the whole of the charge. The apparatus can also be used in connection with the Leyden jar (see below), E being connected, directly or indirectly, with the outer coating, and the hook with the insulated inner coating.

Considerable amusement may be afforded by standing a boy on a dry board of any convenient size, resting on four dry, in fact hot, tumblers, and connecting him by a wire or chain with the prime conductor. If the hand of a person standing on the floor be passed over the boy's head, his hair will be attracted to the hand, and will, therefore, stand erect. When the experiment is performed in a dark room, every tuft of hair will be seen to glow with small brushes of electric sparks, as the charge is conveyed through the hand to earth. Another boy (or girl, for the matter of that) can be employed in drawing sparks from the legs, arms, back, or other parts of the electrified boy's body. His finger placed at a short distance (an eighth of an inch or so) over a gas-burner, will emit a spark which, if the tap be turned on, will ignite the gas.

To a party of young people, few things are more entertaining than a Leyden jar (Fig. 10), which lends itself in a great variety of ways as a source of amusement and instruction. By its aid all the phenomena of lightning can be illustrated; but this is only a small portion of its capacity for entertainment. It is a piece of apparatus very simply made. It is to all intents and purposes the same in principle as Franklin's pane or plate, which consists of a sheet of thin glass, say twelve inches square,

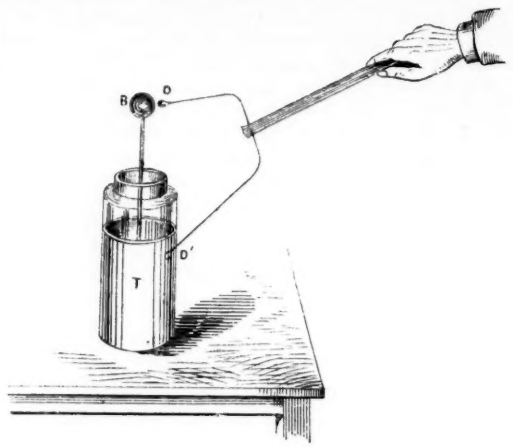


Fig. 10.

having gummed on to each face a piece of tin-foil nine inches square. The inch and a half margin on each face should be coated with shellac varnish. One metal sheet should be connected with the earth, and the other with the prime conductor. The charge on the conductor extends to the connected plate, and accumulates there in virtue of the attraction exerted by an opposite, but equally powerful, charge, gradually induced and accumulated on the opposite or earth-connected side. On a piece of wire, melted into the end of a stick of sealing-wax (for a handle), being connected at one extremity with the earth-connected face and the other extremity brought near the other face, a more or less intense spark will be observed. Perhaps the Leyden jar is a handier form of "condenser," as this class of apparatus is called. It consists of a glass jar or bottle, of say a quart, or even larger capacity, with a neck at least wide enough to allow the hand to be passed in and out readily. The thinner the glass the more efficient will the instrument be, but in the absence of the orthodox shape, a French plum jar will answer admirably. It is coated, inside and outside, with tin-foil (which can easily be gummed on) to within an inch and a half or two inches of the neck, this portion being left uncovered and kept scrupulously clean. A ball, B, an inch to two inches in diameter, either of metal or of wood, coated with tin-foil is attached to a piece of stout wire or rod long enough to reach from the bottom of the jar to two or three inches above the top of the neck, the lower end of the rod being attached to the foil on the bottom (inside) of the jar by a little wax. If convenient, it is perhaps preferable to use a cover or stopper of hard baked wood saturated with paraffin wax, and provided with a hole through which the rod should be passed and fixed in it. In this case the rod need only pass an inch or two below the cover, contact with the inner coating of foil being made by means of a piece light brass chain. Before using the instrument it should be thoroughly warmed to evaporate any moisture that may

have collected on the uncovered glass. To use it, place the knob B in connection with the prime conductor and the outer coating with the earth.

On turning the machine the jar will speedily become charged, and intense sparks will pass on the discharger being presented as shown, the knob D′ being placed in contact with the outer coating, and the other knob, D, brought near the knob B. A piece of insulated wire will answer the same purpose. If, instead of the discharger, a number of boys join hands, and the two end boys touch the jar, one placing his finger on the outside and the other afterwards touching B, a shock will pass through them; but a little care should be exercised, or a shock too severe to be pleasant may be experienced. Two or three turns of the machine should be made, and the effect tried, more prolonged chargings being afterwards administered if the experimenter's *clientèle* can bear it. The contortions and exclamations of those who experience the shock for the first time call forth bursts of laughter and provoke merriment of the most uproarious character.

Equally interesting experiments on the heating effects of the spark can easily be performed. Put a little methyllated spirits in a spoon, and connect the latter with the outer coating of the jar. Then bring a discharger connected with the knob B over the spirit, which on the passage of a spark will ignite. Place a little gunpowder on a slab of stone or brick, connect one part of it with the outer coating of the jar, and connect another part with a piece of wet string attached to one end of the discharger. When the jar is charged, bring the other end of the discharger near B, and the powder will ignite. For another interesting experiment, make a mixture composed of equal parts of powder chlorate of potash and bisulphide of antimony. Make a paper tube a quarter of an inch in diameter, and an inch and a half long, by coiling the paper round an ordinary lead pencil, and gumming the layers together. Fill one end up with a short plug of wood, through which pass two pieces of fine wire, and let them come near each other, taking care that they do not touch, then cover the points with the mixture, fill up with gunpowder, and gum a piece of paper over the open end. Connect the fixed wires by means of other long pieces of wire, one with the outer and another with the inner coating of a charged Leyden jar, when the little "mine" will explode with some violence. By coating the paper case and the connecting wires with pitch, the appliance can be made waterproof, and may then be immersed in a bucket of water and exploded therein, with the result that the water will be blown in all directions, and if the mine or torpedo be a trifle larger in its dimensions, the pail will, in all probability, be blown over. There is no danger of the mines going off spontaneously, but they would, of course, if hammered, or otherwise severely struck. So long as they are handled properly, they can be made and used with perfect safety.

Such are a few of the many experiments which an electric machine can be used for, but few as they are they are quite sufficient to afford entertainment for an hour or two, and in my next I shall deal with another batch of experiments quite as interesting and perhaps more instructive.

It has been said that every man is either a fool or a physician at forty. With equal truth it may be said that at fifty (at latest) every man not a fool is a theologian,—in the sense that he has determined his own system of religion, both as regards worship and conduct.

AMERICANISMS.

(*Alphabetically arranged*).

By R. A. Proctor.*

I HAVE been requested by so many to complete my papers on "Americanisms," that I resume the series, repeating what had already appeared in a late number of the weekly Knowledge as the only way of giving the full set of papers in the current series. It was by an unfortunate mistake that the first part, written when I was in America and sent thence by post, appeared earlier than had been intended; and the mistake had led me to decide on discontinuing the papers, as I neither cared to continue them in a new series, nor to reprint the three columns which had already appeared. As, however, the study of Americanisms is useful in these days, when many American novels are read, and many English writers attempt, more or less successfully, to picture American scenes, the series is now resumed, to be continued monthly till finished.

Abrogans or *Abergoins* is the Western way of calling the natives or Aborigines.

Absquatulate signifies to run away. It is now less often heard than of yore, having been replaced in some degree by the word "skedaddle."

Account, "of no account" is a way of expressing worthlessness. *No account* becomes an adjective: "no account men," Bret Harte says, meaning worthless fellows. The latter usage alone is distinctively American.

Admire. To wonder at. Often used with at. "I admire at that," for I wonder at that. The expression is good old English.

After night, in the middle States, means "after nightfall." English also.

All-fired, a polite form for Hell-fired,—the meaning is not mistakable.

All to pieces, and *all to smash* signify "utterly." English also.

Allow. To assert, affirm, or merely to express an opinion. This expression is often put by English writers in the mouths of Yankees; but as a matter of fact it is only used in the Southern and Middle States.

Along. "Get along" is used in America where in England we should say "get on." Used in many parts of England.

Anan. Leatherstocking's expression. I have only heard this once,—at an eating-house in Pittsburg. The expression is used in Pennsylvania.

Ante. To *ante* a sum, is to risk it. The expression belongs to a game called poker, much played by the lower class of gamblers, horse-thieves, politicians, cowboys, and the like.

Anything else, Not,—meaning "just that." If an American is asked whether some one really did such and such a thing, and he wishes to emphasise his reply, he will say, "He didn't do anything else."

Apple Brandy and Apple Jack. A strong liquor fermented from apple juice. When good, *very* good.

Approbate, is sometimes used in America—incorrectly, of course—for "approve."

Arkansas Toothpick. A bowie-knife, with closing blade. I have never seen an American pick his teeth with an

* I have taken as my chief but by no means my sole authority Bartlett's "Dictionary of Americanisms."

Arkansas Toothpick; but I can believe *anything* about tooth-picking in America. The public display of such arrangements as any American finds desirable for his or her teeth must be regarded as a national institution.

Around. "To be around" is used in America for "to be near" or "by." Thus a preacher in America spoke of Mary as "standing *around* the cross."

As, for "that." "I don't know as I shall go there," &c. "Only heard among the illiterate" says Bartlett; but I imagine that nine out of ten whom I have heard use this ungrammatical expression would be offended if they were described as illiterate. I have heard college professors use it freely. Of course it is often heard in England also.

At is sometimes used for "in," as "at the north" for "in the north."

At that, an odd expression used to intensify something already said, as "He is a Methodist and a hypocrite *at that*;" "he has an ugly wife and a shrew at that." Probably an abbreviation of "added to that."

Awful, used for "very," is purely American, though *awful*, used wrongly as to meaning but rightly as to grammar, is now common enough in England. In the Eastern and Middle States one often hears "awful handsome," "awful hungry," and so on.

Ax, To (for to ask), is a Yankee relic of a very old English word, still used in many parts of England.

Back of is used for "behind"; "you'll find the stick back of that box." Used in England.

Back Down. To "back down" is to yield.

Back Out, To. To retreat. Used in England.

Back track. "To take the back track," is to retreat.

Backwoods, the woods behind or "back" of cleared land.

Bad lands. Waste lands unfit for any sort of agriculture, and hard to travel through. The French settlers called these *Mauvaises terres*, a name still remaining in the form "Movey star."

Bad. Constantly used for the adverb "ill" or for "badly.' I feel bad, is not in America an admission of moral depravity, but means simply I don't feel well. So, "I feel good" is not Pharisaic, but means I am well and happy. "Drink that wine, it will make you feel good," would mean that the drinker will feel jolly after his draught. Where something nice, though (conventionally perhaps) naughty is referred to, the expression "it will make you feel good" has a singularly odd sound in English ears. See *Chemiloon.* (The reference is all right, perplexed reader.)

Baggage, is used in America where we say "luggage." The word "baggage" in England has often another meaning. "To say that a man had a little baggage" with him might be misunderstood in England. A story is told of an English wife in America being told that her husband had arrived with "a little baggage": She went to look for that little baggage with a potato-masher.

Baggage-smasher, the name very appropriately given to the persons who move baggage to and from cars, &c.

Balance, the rest. "Peter and Andrew, with the balance of the twelve, stood around."

Bang-up. First-rate.

Bankit. I heard this expression once only, in New Orleans, for side-walk. (Fr. *banquette.*)

Bay, The Bay State, is Massachusetts. "Let the grand old Bay State proudly," said Lowell, "put the trumpet to her lips," &c., saying, "you go one way we go t'other, guess it wouldn't break our hearts,"—an early cry for Secession,—forgotten subsequently by the North. But the South maintains still that the Northern States were the first to secede from the Union, by failing to adhere to the constitution.

Bayou. The outlet of a lake.

Bear State. The State of Arkansas, so named from its more characteristic inhabitants.

Beat. As a verb, to surpass. "That beats all ever I heerd." Also to astonish, to overcome. "That beats me," means that is utterly surprising to me. But "I'm dead beat" means I'm thoroughly tired.

Beat as a noun also has two meanings. It means some thing or person surpassingly good or effective or surprising, as, "I never saw the *beat* of that." But a "beat" is also one who is thoroughly exhausted, generally in pocket. A "dead beat" is for instance a man without a cent, and not willing to earn a cent.

Bed-spread. A coverlet or counterpane.

Bee. A gathering of friends and neighbours to get through work for a person or family.

A *spelling-bee* is a gathering to test skill in spelling, and tolerably dreary such gatherings are. *Crede experto.*

Bee-line. A straight line,—where in England we should say "as the crow flies," an American would say "on a bee-line."

Being as, an elegant way of saying "since" or "because." "Being as you're a friend," would mean, since you are a friend, or considering that you are.

Beliked, for liked: probably as justifiable in reality, though not by English usage, as "beloved" for "loved." It is, however, often heard in England, too. Shakespeare has "belike" for "probably."

Belongings, used sometimes for property, but occasionally as a euphemism for trousers, a "gentleman's belongings." The former use is good old English.

Bender. To "go on a bender" is to start on a frolic. An unbender would seem nearer the mark.

Best. Used as a verb, meaning to get the better of.

Betterments. Improvements. *Bettermost*, for the best.

Biddy. An Irish female servant.

Big. Used not only for "large," but for fine or excellent, as "big whisky" for whisky of first-rate quality.

Big Bugs. Persons of consequence.

Big meeting. A term applied to camp-meetings, gatherings of people for religious services of the sensational or hysteric kind, a custom invented by the coloured people, but known also in the wilder parts of Ireland. Some persons in America find it good business, I am told, to attend these religious gatherings,—they get a holiday and credit for being more religious than those who keep away.

Biscuit. A biscuit in America means what we would call a hot roll in England. Some are much smaller than our hot rolls; but they are the same in character. They are indigestible to a degree; but Americans will assure you (with face dismally contradicting their words) that hot biscuits are good and healthy food.

Bishop. A "bustle,"—article of feminine gear.

Bit. I must admit great ignorance as to the real meaning of this word. In the South, a "bit" is generally half-a-quarter, *i.e.*, 12½c., equal in value to our English sixpence; but I have known a quarter and a dime (25c. and 10c. respectively) called a "bit." I believe, however, a bit usually means 12½c.

Blamed, condemned theologically, *i.e. damned.* I suppose this particular use of the word belongs to the old country. I had a clerical master who used to say "Blame the boy," with as much unction and as obvious relief as though he had said, "Damn the fellow."

Blanked. Similarly useful.

Blaze. To blaze trees is to cut a mark on them, showing brightly at a distance.

Blazes. Equivalent to *Sheol.* Words beginning with "Bl" seem in favour for strong language. Hence probably the absurd "Blue Blazes," and our vulgar English "Bloody" and "Blasted." (Mr. Max O'Rell's "By'r Lady" for "bloody" is simple nonsense.) Also Blow it, Blast it, &c. It would be interesting to compare scientifically the relief derived respectively from Blame, Blank, Bloody, &c., on the one hand, and Damn, Deuce take it, and Darn it, on the other.

Blizzard. A particularly biting wind. Also a poser.

Block. A set of houses enclosed rectangularly between four streets.

Bloomer. A term applied to costume devised by Mrs. Bloomer,—a short gown, reaching a little below the knees, and pantalettes.

Blow. To boast loudly. "I guess, old man, you're blowing."—*Artemus Ward.*

Blue. Till all's. An amazing expression, generally applied to drinking. "We'll drink till all's blue." I know of no physiological explanation of the expression.

Blue Fish. A large kind of mackerel. The "blue fish wriggling on a hook" was the first American fish I became—vocally—acquainted with, thanksto Mrs. Florence, somewhere about 1856.

Blue grass. The grass growing on the rich limestone land of Kentucky and Tennessee. But in the "Hoosier Schoolmaster," the scene of which is laid in Indiana, we read of "the blue grass pastur'."

Blue Nose. A Nova Scotian, so-named, says Sam Slick, from the blue nose potato, which the Nova Scotian rears in perfection. I would wager a cent, were I a betting man—a cent in America or a farthing in England—that the Nova Scotians were called "blue noses" before the potato which they rear was so named. I guess—after living four years in America I may guess—the name referred to the blueness of nose resulting from intense cold.

Blue Pill. A bullet.

Bluff. Verb. To bet on a worthless hand. This is regarded as a creditable achievement at the noble game of poker. Outside that game, it is generally known as lying.

Board round. To lodge in succession in different families. School teachers were welcomed in this fashion formerly, and perhaps are still boarded in this casual, and (I should imagine) most unpleasant way.

Bogus. Equivalent to our English *Brummagem.* The term has been described as a corruption of *Borghese*, the name of a man who forged bills half a century or so ago. The explanation seems doubtful,—a bogus explanation in fact.

Boiled shirt—or more frequently *Biled Rag*, a clean shirt: a singularly graceful expression.

Bolt. Verb. To bolt a candidate is to omit to vote for him.

Bonanza. Spanish. A big scheme, by which (honestly or otherwise) much money is made.

Boodle. (Fr. *Botel*; Germ. *Beutel*; our English *Bottle* is of similar origin.) A set or lot. The "whole boodle," the whole lot. Somewhat emphatically contemptuous.

Boost. To hoist. Old English.

Boss. (Dutch *Baas.*) A master or overseer. As an adjective "boss" means "biggest."

Bottom Dollar. The lowest dollar of a heap set beside the gambler wherewith to back his luck. "You may bet your bottom dollar," is equivalent to "you may go your whole pile" (of dollars). One of the elegant offshoots of American gambling.

Bound. Meaning "sure," also "resolved."

Bourbon. Whisky from Bourbon county, Kentucky; the best whisky I know. (If you know any better, then —*candidus imperti; si non, his utere mecum.*) Also, a term applied to Democrats.

Box Car. A close car, used to convey furniture by rail.

Boy. In the south this word usually means a coloured male servant.

Brainy. A man who shows brain power.

Breakdown. A riotous dance, closing a ball.

Britishers. Americans say that this word is purely British, no American being ever heard to apply it to Englishmen. Bartlett says in his "Dictionary of Americanisms" "We never heard an American call an Englishman a Britisher." Curious! I had not been in America ten days, before I had heard many Americans speak of Englishmen as Britishers — generally, as "blarsted Britishers." Oddly enough, Englishmen lay themselves open to similar contradiction, when they assert that this word "blast" with its derivations "blasted, blastedly, &c.," is much oftener heard in America than in England. No one but a blackguard in England ever uses the word; but in America they are so fully assured that every Englishman is always "blasting" that they use it freely. So with "bloody"; it is a familiar word with English costermongers, but no respectable Englishman ever uses it: now it is thought nothing wonderful for an American lady to speak of "crying bloody murder," or of "rawhead and bloody bones," at which her English cousin, unless of low grade, cannot help shuddering.

Broncho. A native California horse, of somewhat lively type.

Brother Jonathan. A term originally derived from a saying of Washington's about Governor Jonathan Trumbull of Connecticut. "We must consult Brother Jonathan about this," said Washington on one occasion; and this became a byword. Few Americans are christened Jonathan, perhaps, but just as Englishmen are called John Bull, so Americans are called and call themselves Brother Jonathan.

Broughtens up. Bringing up. A credit to his "broughtens up."

Brung. Niggers say "brung" for brought. It is necessary to add that white folk occasionally use this elegant form, by way of joke (very mild).

Buck. A buck nigger is a full-grown black man.

Buckeye. Ohio men are called Buckeyes. Ohio is *the Buckeye State*, so named from the Buckeye Tree *Æsculus glabia*, which grows freely in Ohio.

Buckra. A white man. Nigger talk.

Buffalo. The American Bison. Also the bison's skin, or buffalo robe. They tell absurd stories of Englishmen who, hearing of a "buffalo" when a drive has been in preparation, have imagined that a bison was to be harnessed.

Buffalo Wallow. A depression in the prairies caused by rains. Bisons delight to roll in these hollows, which are therefore (!) called buffalo wallows.

Bug. Americans use this word more freely than Englishmen,—not limiting it, as we do, to *Cimex lectularius*—all insects are bugs in America.

Build. To build a fire in America is to make one.

Bulge. On the. On a big spree, (this perhaps is explaining *obscurum per obscurius*): to get horribly drunk in the company of unpleasant people, with fighting, followed by a day's sickness and several days' discomfort.

Bulldose. To bully. Bulldose was originally equivalent —so they say—to cowhide,—somewhat as a man who is bullied is apt to be cowed.

Bullion State. The State of Missouri. (A former

Missourian Senator, Mr. Benton, strove hard to obtain a bullion currency.)

Bully. *Adj.* and *adv.* Fine or finely.

> Now is the time for a *bully* trip,
> To shake her up and let her rip.
> *Boatman's Song.*

"Bully for you," means "well done you.

Bullyrag. To revile. Thus they *bullyrag* the presidential candidates till one or other is elected; after which bullyragging is considered bad form.

Bummer. A lazy, idle loafer.

Bundle. Verb. Obsolete. A man and woman lying on the same bed, in their clothes, were said to *bundle*, or to *be bundled*. For the full significance of the word, and the propriety of the practice, see Irving's "Knickerbockers." The Rev. I. Peters, in his "General History of Connecticut," says that though it would be accounted the greatest rudeness for a gentleman to speak before a lady of a garter or a leg, yet it was thought but a piece of civility to ask her to *bundle*." He shows that bundling was not only a Christian custom, but a polite and prudent one!

Bunkum, or *Buncome.* Talk not meant to be taken *au grand sérieux*. A member for Buncombe, who bored many out of Congress, told the rest they might go, he was only talking for Buncombe. The practice is unknown —I need hardly say—in the old country.

Burgle. To commit burglary. Much older than the "Pirates of Penzance."

Bush Meeting. The original negro form of the modern camp-meeting. A relic of Jumboism.

Bushwhacker. The equivalent of our English Clodhopper,

Bust. A frolic. To go on a bust, is to go on a big spree. (See "Bulge.)

By and again. A Southern expression for "now and then." In England I have often heard "now and again," in this sense.

By and large. On the whole.

ANTHROPOID APES.*

THERE can be little if any doubt that by far the larger part of the insensate and unreasoning rage with which theologians have attacked and abused the theory of evolution has had its origin in that human pride which disdains to admit of the existence of any actual affinity among the higher orders of the mammalia. That any community of lineage should be claimed on anatomical and physiological grounds between the two Linnæan families of *Homo sapiens* and *Anthropormopha* is sufficient to set a good many well-meaning and conscientious (if slightly ignorant) people shrieking hysterically concerning the fearful impiety of the suggestion of those patient observers who, little by little, have shown the origin of mankind, beyond any cavil or question from any one competent to understand evidence. Everyone who wishes to understand the grounds on which it is held that man and the highest apes have a common ancestry will find them lucidly, philosophically, and temperately set forth in Professor Hartmann's book. That, as stated some years ago by Professor Huxley, the lower apes are further removed from the higher apes than the latter are from man, has never been seriously impugned; the allegation being however generally met with an attempted intellectual comparison between the gorilla, chimpanzee, or ouran-outang of the menagerie with Bacon, Shakespeare, or Newton. The fallacy and unfairness of such a comparison needs only to be stated to become evident to anyone who has ever seen a Fuegian, Bosjesman, or lower native Australian in a state of nature. For it is not intellectual purity which forms the bond of union between the anthropoid apes and the human species, or is adduced as proving it, but anatomical and physiological relations of a character practically identical, which are set forth in minute detail in the work to which this short notice is designed to direct attention. Everybody familiar either from personal observation or authentic drawings with the aspect of many tribes of negroes or of Guaranis, Malays, and Papuans will admit that their external approximation to the simian type is of the closest. Nor need the ape always fear comparison, even from a psychical or ethical point of view, with so-called "civilised" man. Without repeating Darwin's well-worn anecdote of the little American monkey which attacked the fierce baboon to save his keeper's life, we may take a recent police report, cut almost at random out of a daily paper, and contrast the behaviour and sensibility of the "Lord of Creation" who figures therein with that manifested by Mafuca, the chimpanzee at the Dresden Zoological Gardens, as narrated by Professor Hartmann. In the *Standard* of Nov. 9th, we read:—

> John Dunkin, 43, a hawker of umbrellas, was brought up, on remand, charged with causing the death of Elizabeth Jackson, a woman with whom he was living, at 3, Medland-street, Ratcliff. Last Thursday week the prisoner and the deceased woman were seen quarrelling, owing to the prisoner wanting to go and pawn the boots he had been wearing. He was then seen to strike the woman at the back of the ear with his hand, but whether his fist was clenched or not could not be said. When Jackson arrived at the lodging-house she was bleeding from the face, and also from a wound behind the ear. In answer to a question put to her by the deputy of the lodging-house, she said, "Patsy did it." A woman named Mary Ann Walford said she saw Jackson down on the landing, opposite her bedroom, and the prisoner was standing over her, and when about to kick her he was prevented. Another woman stated she saw Dunkin kick the woman in the stomach and side, and she fell to the ground. Dunkin was then heard to say, "If I had my big boots on, I would kick your face in." The woman then became very ill, and in a short time afterwards she died. When the police came and arrested the man, he asked, "Is she dead?" On being told that she was, he clenched his fists, and, looking very savagely at the corpse, said, "Nobody shall know her. I will disfigure her." A medical man stated that on the back of the ear was a lacerated wound, which was quite recent. The cause of death was heart disease, accelerated by drink and excitement. The woman must have been a hard drinker, and excitement might have been caused by the knocking about she had received. The blows might also have accelerated death. No further evidence was now adduced. Mr. Lushington committed the prisoner for trial.

Which of the so-called "brutes" could or would so degrade itself as to act towards the corpse of its fellow as Mr. Dunkin is here alleged to have done? Let us contrast the feeling he showed with that exhibited by the despised ape, when her end was approaching. Premising that Schopf was the Director of the Zoological Gardens, at Dresden, we read, "Just before her death, from consumption, she put her arms round Schopf's neck when he came to visit her, looked at him placidly, kissed him three times, stretched out her hand to him and died. The last moments of anthropoids have their tragic side." Let us beware lest in our anxiety to assert our own supremacy we are led into the moral cant. To all who wish to see a most able *résumé* of the facts from which the common origin of Man and the Anthropoid Apes must be inferred we would heartily commend the volume before us.

* "Anthropoid Apes." By Robert Hartmann. International Scientific Series. (London: Kegan Paul, Trench, & Co. 1885.)

SOMETHING ABOUT THE INDIAN SPARROW.

(COMMUNICATED.)

YOU at home, who are accustomed to diginess, shyness, and not overpowering twittering in your *Passer domesticus*, would be mightily astonished and amused at our sprightly and perky *P. Indicus*, which is far ahead of your bird in its familiar vulgarity and pugnacity.

Jerdon ("Birds of India," Vol. II., p. 368) tells us that "the common sparrow of India differs very little from that of Europe. It differs chiefly from *P. domesticus* in the greater purity of its colours, and in the female being somewhat paler. It is smaller, too, than its European congener."

I am not certain myself of the difference in size, but of that in plumage there is hardly a doubt, simply because our sparrow has not smoke and fog to contend with like its cockney brother, and is, therefore, always clean, and can make the most of its plumage, sombre though it be.

In one respect, the English cannot approach the Indian sparrow—and that is in its domesticity. The former, more or less, lives on man, but the latter not only lives on him, but *with* him, and this co-partnership is at times exceedingly unpleasant.

In the latter respect, the Indian is similar to what the Jewish sparrow must have been in sacred history. They must have been plentiful, for five were "sold for two farthings"; they must have frequented roof-tops, for Josephus tells us that the Temple roof was protected against birds by golden spikes; and, lastly, they must have nidified within the Temple precincts, for a young one, fallen from its nest, may have elicited from Christ the cheering words that even its accident was not without Divine knowledge and permission.

Like that sleek, black-coated ruffian, *Corvus splendens*, the Indian crow, the Indian sparrow lives upon man, and, like the crow, is never found in desolate places. As I have said, not only does he live upon man, but he lives with him; man supplies him alike with board and lodging, and, what is more, he is very particular with whom he will board and lodge. Partial to toast, he looks out especially for quarters where he will get it buttered on *both* sides.

In apparent contradiction to what I have written, he is, like the church mouse, of a religious, or rather ecclesiastical, turn of mind, and largely infests our churches, whence, from their open architecture (for the purpose of ventilation), it is impossible to exclude him.

He scandalises our services by drowning them with his deafening chirruping and scolding—nay, he chooses the most solemn moments for exhibiting his fighting tendencies. What would a curate at home say to a pair of fighting cock-sparrows suddenly alighting on the Bible as he is reading a Lesson, and then and there having it out, tooth [? R.P.] and nail, with enormous vituperation into the bargain? What would a devout worshipper say to the same encounter commencing suddenly on his bald head, and ending in his prayer-book? Out here we have to put up with their annoyances as matters of course, but the severity of the struggle can be estimated when I declare that, in some stations, these fiends contest your meals with you, picking at your bread, stealing your butter and rice, and purloining your sugar.

Drive them away, and they will perch upon your punkah ropes, awaiting a favourable moment for re-attack. The pertinacity with which they stick to their building sites is very remarkable and annoying; perhaps they have selected a spot above your study table, and you can't dislodge them; any day you may have a bushel of rubbish dropped upon you—twigs, straw, rags, &c., and every day you may pull down the nest. But in vain, hatching goes on, and then you may run the gauntlet of egg-shells, rotten eggs, or fledglings dropped upon you (*vide* note). I have known sparrows nidify above a bed, have tremendous fights on it, unmindful of its occupant, drop all the above-mentioned rubbish upon it in regular instalments, and carry their point by having the bed removed.

Such are some of the performances of *P. Indicus*, and I venture to affirm that they are never approached by *P. domesticus*. Like its British brother, our Indian sparrow has never been domesticated; it resents confinement, and resists all attempts at taming. In reality it is not worth it, for it has no voice, no plumage to attract the eye, and no accomplishments.—R. F. HUTCHINSON, M.D.

Note.—I discovered in 1858 that, during the hot weather, crows, kites, mynas, sparrows, &c., left hatching to the heat of the weather during the day, and sat at night. In those days I collected birds' eggs, and, when not at liberty to blow them, placed them in one of my office table drawers. On two occasions I heard strange noises issuing from the drawer, and, opening it, found, on one occasion, a crow, and on another a myna fledgling. I tried hard to rear both, but failed.

TWO EXTERNAL GALAXIES.—Are not the two Magellanic Clouds probably external galaxies resembling our own? If we consider the evidence this view will, I think, appear highly probable. It is clear that the star clouds of all orders are part of our own galaxy; for their arrangement on the star sphere corresponds far too accurately with the arrangement of the stars to admit of any other interpretation. We may feel just as sure that the star clouds, which are always found where stars are not, are part and parcel of the galaxy, as an insect might feel that the leaves in his tree-home which are always found outside the boughs and at some distance from their more solid parts are part and parcel of the tree to which those boughs belong. But have we not just the same sort of evidence that the Magellanic Clouds, or *nubeculæ*, are galaxies like our own, when we find that in them stars of as many varied orders of real size are combined as we find in the galaxy itself? If the insect who had learned to recognise the tree as containing parts so dissimilar as the trunk, the boughs, the branches, the twigs, the leaves, and the blossoms, were to look forth beyond the tree and to see in some distant object what resembled exactly the trunk, bough, branches, twigs, leaves, and blossoms of his tree-home, would he not be justified in concluding that that remote object was a tree like his home? Now, we have just such evidence. We have in the Magellanic Clouds every one of the features which our galaxy would present if seen from a distance. There are stars of the seventh magnitude, which we may regard as being suns like Sirius, Vega, Altair, and other stars of the giant order, removed to many times the distance of the leading orbs of our galaxy. Then there are fainter stars of all orders down to those so faint that they cannot be separately discerned with the most powerful telescopes we have, and appear only as milky nebulosity. There are star clouds of all orders; and, lastly, there are vast regions of gaseous matter akin to the great Fish-mouth nebula in Orion, and the great Key-hole nebula in the constellation Argo. If the *nubeculæ* are not external galaxies resembling our own, they present at any rate all the appearances which such galaxies would present from a very distant standpoint.

Gossip.

By Richard A. Proctor.

For reasons connected with changes in regard to publishing and printing which will become apparent in the next number, the present is in some degree chaotic. Matter already in type when the changes were called for had to be employed where in the ordinary course other matter would have been more suitable.

* * *

Next month my Southern Star-maps will be continued, but in another form. They have not come out at all well on the black ground. I hope next month to have also pictures of Mars and Jupiter, the two planets which now present so conspicuous an appearance in our skies.

* * *

Next month, too, I hope to give the first of a monthly series of papers on the Face of the Sky, by "A Fellow of the Royal Astronomical Society," whose former fortnightly contributions under that heading were much valued.

* * *

By the substitution of the word "fertility" for "futility" (at p. 133, col. 2, line 9), rather lively nonsense has been made of my remarks about the prevailing of law and the failure of lawlessness.

* * *

My "Historical Puzzle" seems to have puzzled many in a way I should hardly have supposed possible. I have received appeals from opposite sides to reconsider my conclusion—having expressed *none*. Several proclaim their opinion that I have been most unjust to Josephus; many more consider that I have been most unjust towards the writers of the gospel narratives. Now in reality, I have only said with regard to Josephus that *if* Dr. Farrar is right in attributing to him deliberate falsification of history, by silence about matters of which he must have known if they had occurred as described by others, *then* he was guilty also of offences against literary honesty, in borrowing from the stories of those other writers, and working the borrowed material, without acknowledgment, into his professedly accurate history. As for the gospel narratives assuredly they speak for themselves; I have expressed no opinion whatever about them: those who consider that the passages I quoted from Josephus convey unsatisfactory impressions express their own feelings only. I asserted nothing of the sort. I quoted passages which are there in the book, and whose close resemblance to passages in the gospels cannot be doubted. What interpretation is to be given to the peculiarity I leave undecided—except that I put mere chance coincidence on one side as practically impossible.

* * *

The logical absurdity of that singular sort of faith which is afraid to notice facts lest faith should be shaken, I find myself unable altogether to appreciate. Like the unconditioned it is beyond the mental grasp—being in fact irrational. Don Quixote though certainly not altogether sane, submitted his card-visor to trial: that the new helmet remained untried, has generally been supposed to indicate an uncomfortable doubt lest if test were applied he would have had to make him a third helmet.

Owing to the incomplete working of a rather complex correction in proof, a passage relating to the interpolated passages in Josephus reads as if Photius were a predecessor of Origen, instead of following him by several centuries. The passage relating to John the Baptist was not inserted after Photius had dwelt on the absence of any reference to John; but the manuscript known to Photius in the ninth century, presented probably the original form of the account of the doings of Herod the Tetrarch, Aretas, Tiberius, and Vitellius. The internal evidence is so strong against the authenticity of the passage relating to John the Baptist, however, that Photius would almost certainly have regarded the passage as an interpolation, if it existed in the copy which he studied. Only, in that case he would presumably have mentioned its existence; and he does not.

* * *

I know that Dr. Farrar speaks of this passage without casting doubt on its genuineness. But theologians are very poor judges, as a rule, of such matters, their wishes usually proving very fertile parents of conclusions which seem acceptable to them. The passage, without the matter relating to John the Baptist, runs thus:—

> So Herod wrote about these affairs to Tiberius; who, being very angry at the attempt made by Aretas, wrote to Vitellius, to make war upon him, and either to take him alive, and bring him in bonds, or to kill him, and send him his head. This was the charge that Tiberius gave to the president of Syria. So Vitellius prepared to make war with Aretas, having with him two legions of armed men; he also took with him, &c., &c., &c.

* * *

Into the midst of this passage, the piously fraudulent interpolator, seeing no better place wherein to drag in John the Baptist, has foisted a passage about that worthy, so ingeniously misplaced that it is *apropos des bottes* in the first place, while in the second it makes the reason for Vitellius going to war with Aretas appear to be the offence of Herod in killing John. Doubtless the interpolator had not much choice. He would have to bring in his pious fraud at the close of a section. Had he been able to pitchfork it into the middle of section I. chap. v., it might have done very well. But coming after the close of that section, (which ends with the words "president of Syria") its absurdity would strike any one except a theologian determined to find what he thinks he ought, and knows he would like, to find. "This was the charge," says Josephus, "which Tiberius gave to the president of Syria. *So*,"—the president of Syria did what he was bid. But the interpolator crams in after the charge a long rigmarole beginning "*Now*, some of the Jews thought that the destruction of Herod's army came from God, and that very justly, as a punishment of what he did against John, that was called the Baptist," &c., &c. Then, after giving the reader ample time to forget all about the order given to Vitellius, and not in the least recalling that order to the reader's mind, the narrative as improved by the interpolator, goes on "So Vitellius prepared to make war with Aretas," &c.

* * *

The interpolator here, as in the passage relating to Christ, was a bad hand at his piously fraudulent business. Some of the ingeniously pious persons who produced epistles from Abraham, nay from Christ himself, and were ready to compose epistles by Peter and Paul, would probably have managed the interpolation a great deal better. But it must be remembered, in considering the

clumsiness of this particular rogue, that it was not quite so easy a matter to bring into Josephus's narrative persons whom either he carefully ignored or else knew nothing about. The attempt would be like trying to introduce a chasuble as part of the costume of a Roman soldier, in an ancient painting correctly presenting the warlike garb of Rome's defenders.

* * *

MR. JOHN RUSKIN has done good service in recording his opinions about Darwin, Gibbon, Kingsley, Mill, Voltaire, St. Augustine, and Grove; for though no one of any sense will accept his venom for good medicine, he has managed to set a strong black mark against the writings—nay against the whole mental and moral character—of a man not included in the list of widely-read authors whom he tries to vilify. John Ruskin *versus* Darwin is Impudence *versus* Dignity with a vengeance.

* * *

AS some critics—who must be singularly keen—regard my introduction of a paragraph headed "A Positivist View of the Sermon on the Mount" as a proof that I am myself a Positivist, I may take the opportunity of remarking that I am not a lover of retrogression, and that I regard Positivism as the most retrogressive idea of religion existing, and as therefore hopelessly impossible. But indeed its history—its rise, progress, decay, and obviously approaching demise—show as much.

* * *

ALBEIT, for Comte's keenness of vision in certain directions I have a high respect.

* * *

LAST month, for reasons connected with the change mentioned above, much matter set up under my own name had to appear, or the type be distributed. A critic of the cheap sort is kind enough to suggest that much more of the number was of my writing. He regards me as identical with Mr. Clodd, with "A Fellow of the Royal Astronomical Society," with "Mephisto," and with the author of the Whist game. He also regards me as author of the notices of books. In this he pays me a fourfold compliment of a very high character. On nearly all matters which we have studied in common I think much as my friend Mr. Clodd does; but if of an envious nature, I should certainly envy him the graceful and felicitous style shown in his "Childhood of Religion" and other charming works. My friend "A Fellow of the Royal Astronomical Society," has become more widely known by his admirable letters in a contemporary than thousands who have sought fame for their own name. The Whist game in last month's number like that in the present is by one of the finest living players; and "Mephisto" achieved such success last year in triumphing over Blackburne, Mackenzie, Mason, and others, as to have made a name among the absolutely "first-best" chess players of the day. As for the notices of books the great majority were not from my pen.

* * *

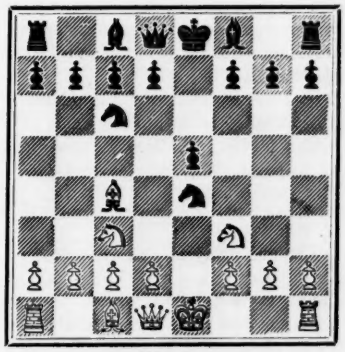
I SPEAK above of "cheap critics." A critic in *Health* appears to have taken this expression (used in the preface to my "Strength and Happiness") somewhat to himself—which is not my fault. He dwells on his objections, for the odd reason that "critics have usually treated Mr. Proctor very kindly." I admit the soft impeachment: but there are critics and critics.

Our Chess Column.

BY MEPHISTO.

EVEN among the best of Chess players there are but very few whose memory is equal to the task of retaining the different variations of each particular Opening. It would, therefore, seem to be unreasonable to expect an ordinary player to discern analogous variations in the Bishop's Opening, Two Knights Defence, Petroff's Defence, Four Knights game, &c. But we intend to make our readers acquainted with a main variation in all these Openings, without asking them to commit many variations to their memory, but simply by impressing the picture of the one principal position upon their minds.

BLACK.



WHITE.

This is a position not unfavourable to the second player, for if White now plays 5. Kt × Kt, P to Q4 follows with a fair game. 5. B × P (ch) likewise gives White no advantage, for Black replies with K × B then 6. Kt × Kt, P to Q4. 7. KKt to Kt5 (ch), K to Kt sq. 8. Q to B3, Q to Q2! 9. Kt to QB3, P to KR3. 10. Kt to R3, Kt to Kt5, &c. Black will have a better development in spite of the position of his K. White's best move is 5. Castles; this we will examine later on.

Now by bearing in mind the above position, our readers will be able to defend themselves against an attack which constantly causes the loss of many games, because it may be brought about by a transposition of moves of the various Openings we have mentioned above. To avoid future danger we will show how this position may be arrived at in these various Openings.

	Bishop's Opening.	Petroff's Defence.	Two Knights Defence.	Four Knights Game.
1.	P to K4 / P to K4	P to K4 / P to K4	P to K4 / P to K4	P to K4 / P to K4
2.	B to B4 / Kt to KB3	Kt to KB3 / Kt to KB3	Kt to KB3 / Kt to QB3	Kt to KB3 / Kt to QR3
3.	Kt to KB3 / Kt × P	B to B4 / Kt × P	B to B4 / Kt to B3	Kt to B3 / Kt to B3
4.	Kt to B3 / Kt to QB3	Kt to B3 / Kt to QB3	Kt to B3 / Kt × P	B to B4 / Kt × P

White's continuation, as indicated, would be:—

5. Castles	Kt × Kt
6. QP × Kt	Q to K2
7. R to K sq.	P to Q3
8. Kt to Kt5	Kt to Q sq.
9. P to B4	P to B3
10. P × P	QP × P
11. Q to R5 (ch)	P to Kt3
12. Q to R4	B to Kt2

If P × Kt, 13. B × P, Q to B4 (ch). 14. K to R sq., and White will

have a strong compensating attack. If, for example, Black continues 14. B to K2. 15. P to QKt4, &c. Or if 14. Kt to K3 then 15. B to B6, &c.

13. Kt to K4 B to K3

and Black has the better game.

This is a safe way of defending Black's game against an attack first practised by Kiescritzky, which, through want of the proper defence, often causes the speedy loss of the game.

This is as follows:—1. P to K4, P to K4. 2. B to B4, Kt to KB3. 3. Kt to B3, Kt × P. 4. Kt to B3. We have previously shown how this position may be brought about in various ways, also that Kt to QB3 is Black's reply But supposing

4. Kt × Kt
5. QP × Kt

P to Q3 is bad, for White can now play 6. Kt × P (and if P × Kt, 7. B × P (ch) wins the Queen). 6. Q to K2. 7. B × P (ch), K to Q sq. 8, Castles, with a good game. If now Q × Kt. 9. R to K sq., followed by R to K8 (ch), &c. If, instead of P to Q3, Black plays 5. Kt to B3, White will at once get an advantage by 6. Kt to Kt5, which move would also follow upon Black playing B to B4. The only correct play for Black is

5. P to KB3

But even then Black will have a difficult game to play, especially against a stronger player. White can now proceed either by 6. Castles or 6. Kt to R4. If

6. Castles Kt to B3
7. Kt to R4 P to KKt3
8. P to B4, &c.

The attack may assume many other forms, all of which, however, may be avoided by bearing in mind the position given above, and playing accordingly to reach it.

As an illustration of the more complicated defence after Black's playing 4. Kt × Kt (instead of Kt to QB3); 5. QP × Kt, P to KB3, we append a game played last year at Wiesbaden by the veteran Chess-master, Baron van der Lasa, the esteemed compiler of the German Handbook, and the sole surviver of the seven illustrious players who, nearly half a century ago, acquired the title of the Berlin Pleiades of Chess, Baron von Heydebrand has since many years past withdrawn from active play, and devoted the attention of his leisure moments for Chess almost exclusively to the history and literature of the game—a department in which, we believe, he has no living equal.

King's Bishop's Opening.

White. Baron der Lasa.	Black. Herr C. Beck.	White. Baron der Lasa.	Black. Herr C. Beck.
1. P to K4	P to K4	12. Kt to Kt6	P × Kt
2. B to B4	KKt to B3	13. Q × R	B × P
3. KKt to B3	Kt × P	14. B to Q3	B × B
4. Kt to B3	Kt × Kt	15. P × B	Q to Kt2
5. QP × Kt	P to KB3	16. Q to R3	B to K2
6. Kt to R4	P to KKt3	17. Q to K6	P to B4
7. Castles	Q to K2	18. P to KKt4	P to B5
8. K to R	Kt to B3	19. B to Q2	B to B3
9. P to B4	P to Q3	20. K to Kt2	Kt to K2
10. P to B5	P to KKt4	21. P to B4?	P to R4!
11. Q to R5 (ch)	K to Q	22. B to B3?	R to R3!

And White resigns.

Our Whist Column.

GAME II.

THIS game, like the game which appeared last month, is by that Whist-master, Mr. F. H. Lewis, as are the notes. The games admirably illustrate the arguments for and against Whist signalling. In last month's hand a player seeing the importance of leaving the adversary in the dark, omits the conventional indications with regard to his hand and thereby saves the game. In the present hand, B's unfortunate signal gives the game to the enemy.

THE HANDS.

B { H (*trumps*). Q, Kn, 9, 6, D. K, 9, 5. / S. 8, 5. C. A, Q, 10, 7. }

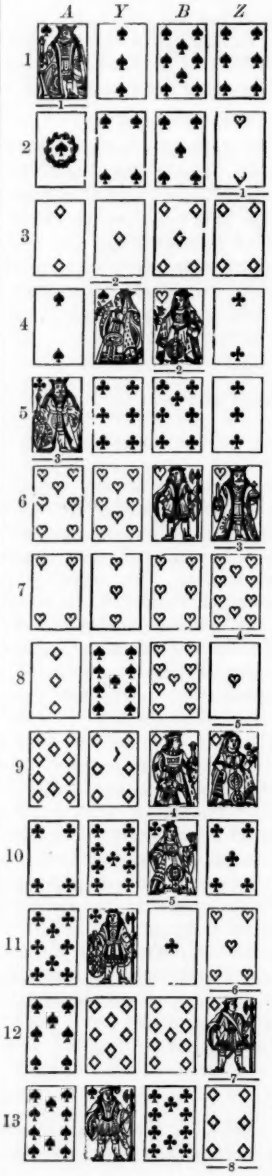
Y { H (*trmps*). 8, 3. / S. Q, Kn, 9, 4, 3. / D. A, 8, 7. / C. Kn, 9, 6. }

B / Y Z / *Tr. H.* 10. / A leads.

A, K, 10 5, 2. / 6. / Q, Kn, 6, 4. / 5, 3, 2. } *Z*

A { H (*trumps*). 7, 4. D. 10, 3, 2. / S. A, K, 10, 7, 2. C. K, 8, 4. }

Score:—*A-B*, 2. *Y-Z*, 3.



NOTES TO GAME 2.

Note.—Card underlined takes trick, and card next below leads next.

1. *B*, who has justifying strength in trumps, and, with his partner's lead, a beautiful hand, commences a call; he does not wish to be forced.

2. As the call is developed, *Z* properly gives no information, but trumps with his lowest.

4. *Y* plays Spade Queen in the hope of giving *Z* a discard. *B* is in difficulties. The ten having been turned, he must trump with an honour. He selects a false card, but *Z* is in a position to recognise it as such, having himself the two commanding honours. He, therefore, most wisely discards.

5. *B* having been left in possession of the trick, cannot continue a trump. If *Z* was playing truly his Knave is apparently safe. He therefore opens his strong suit.

6. *A*, who is not in a position to form an adequate judgment, obeys his partner's call, and leads up to destruction. *B* must play the Knave having reference to the turn-up card.

7. *Z* properly continues the trump, and, no player having failed, is in a position to exhaust *B*'s trumps.

9. *Z* now continues his own suit, and with the long trump is enabled to bring in the long Diamond and win the game.

The game is an instance of legitimate information being more advantageous to the adversary than to the partner.

Next month the first of two important papers by "Mogul" on "Leading at Whist," will appear in our Whist Column. We hope also to have his permission to publish with that first paper a series

of Whist hands which he has suggested as tests of the methods of leading likely to be followed by good players. Nothing can be better than to deal with tests of this kind: because, in considering what one would do in a test case, and noting what other players would do, one learns the true principles which should govern Whist in actual practice, depending as this does largely on the consideration of what other players are likely to do.

A remark of mine (as "Five of Clubs") about a rule touched on by "Pembridge" in regard to not leading from a long weak suit without re-entering strength, has been misapprehended by the able Whist-editor of the *Australasian*—though the fault is certainly my own. I spoke of the rule "laid down by 'Pembridge'" when I ought to have said the rule "stated" by him.

Recent Inventions.

[The following paragraphs were left standing when the last number of weekly KNOWLEDGE came out, and appear now owing to the change in publishing and printing arrangements. We do not propose to continue the description of recent inventions, which are unsuitable to KNOWLEDGE in its monthly form.]

GRACE'S PATENT EPICYCLIC ELLIPTOGRAPH.

[Patent, No. 4,582].—The Epicylic Elliptograph (Fig. 1) consists of a cross frame, O, supported by uprights at each end, carrying at the centre the operating handle G, and the mechanism; which is such, that while the handle, G, by means of a central pivot, gives the inner arm, H, attached to it underneath, any given angular motion in either direction, the wheel-work C D E F A R S S′ B, by means of a cannon pinion attached to the wheel F, and fitted round the central pivot, gives the outer arm, L, an equal angular motion in an opposite direction, which causes the pen, M, fitted on the outer arm, L, to move in an elliptical path.

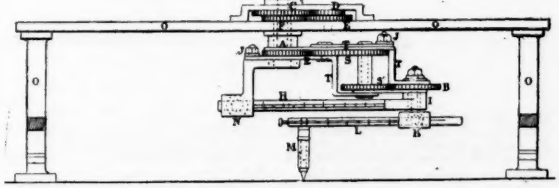


FIG. I.—Grace's Epicyclic Elliptograph, for describing ellipses of various sizes and proportions, from a point upwards. Relative diameters of the wheels:—A=3; D=1; E and F=2; A R and S=2; S and B=2½.)

It can be set to describe ellipses of any given proportion, from a straight line to a circle, and of any size, from a point up to twenty inches by ten inches and over, by varying the length of the inner arm, H, and the outer arm, L, by means of the fixing-screws J K and N, and the graduated scale on the arms, so as to make the inner arm, H, equal to one quarter the difference between the major and minor axis of the required ellipse, and the outer arm, L, equal to one quarter of their sum, or vice-versâ, the inner arm, H, can be made equal to one quarter their sum, and the outer arm, L, equal to one quarter their difference. And after adjustment for the given size and proportions, the required ellipses can be drawn, with their axes, at any convenient angle with the cross frame O.

It is also made so that pairs of equal change-wheels of various sizes can be fitted; one on the under end of the cannon pinion of wheel F, and the other on the up end of the pivot I, to vary the length of the inner arm, H, instead of the permanent jointed frame and wheels, T T; and, by altering their relative size, the instrument can be used to describe various symmetrieal curves and scrolls for ornamental purposes.

The principle of the motion of the above elliptograph and its adjustment can be proved mathematically.

The elliptograph, having only a single cross-frame, is of smaller relative size than the ellipto graphs constructed on the tramme[l] principle, which require a double cross-frame, equal in length to the difference between the major and minor axes of the most elongated ellipse they will describe, and it also requires a simpler movement of the handle to operate it.

The elliptograph, with or without change-wheels, can be obtained of Mr. Harling, 40, Hatton-garden, E.C.

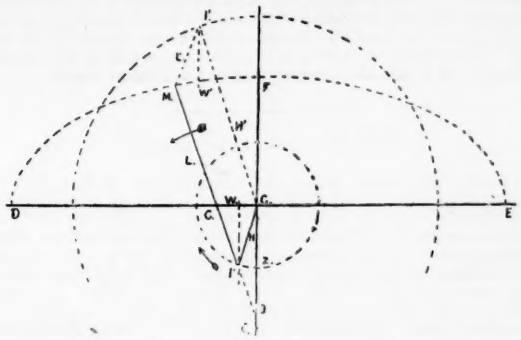


Fig. 2.

Proof.—In Figure 2, let M I = the outer arm, L, of the elliptograph, and G I = the inner arm, H. Let D E = major axis and F O = the minor axis of any ellipse, and let M I be produced to meet the minor axis, F O, in the point B. Let the vertical line, I W, be drawn perpendicular to the major axis, D E, and the horizontal line, I Z, be drawn perpendicular to the minor axis, F O. Then, as by the construction of the above epicyclic elliptograph, angle C I W always equals angle I G Z, and the angle W I G also equals the alternate angle I G Z, consequently the angle W I G equals the angle C I W, and, therefore, the right-angled triangles G W I and C W I, having the side W I in common, are similar and equal, and the hypotenuse C I, equals the hypotenuse I G; and it will be seen that the right-angled triangle C W I is similar and equql to the right-angled triangles I Z G and I Z B, as both the angles, I G Z and I B Z, equal angle C I W, and their side, I Z, being equal to side W G, is also equal to side C W. Therefore, their hypotenuses, viz. the lines or part, I G – I G and I E, are equal in any position of the line or arm, M I, produced, and consequently the point C is always on the same straight line as G W produced, viz. the major axis E D, and also the end or point B is always on the line G Z, produced, viz. the minor axis, F O, produced or otherwise, as the right angles of the pair of triangles are adjacent. And as, by the principles of ellipses, any point M, on part B C, produced beyond C on the major axis, will describe an ellipse, therefore, as part I M represents the outer arm of the above epicyclic elliptograph, the extremity of the outer arm, L, of the above epicyclic elliptograph will describe an ellipse. And as from the principles of ellipses the part C B must equal the difference between half the major and minor axes of any required ellipse, and as from above the parts I C, I G, and I B are equal, therefore C B, or ½ (major – minor axis) equals the two parts, C I and I B, and is, consequently, equal to twice I G, and consequently I G, viz. the inner arm of the above epicyclic elliptograph, equals half of half the difference between the given major and minor axes; that is, one quarter the difference between the major and minor axes, which is according to the rule for setting the inner arm, H, of the elliptograph. And, also, as I G equals ¼ the difference between the given major and minor axes, and as I G = I B, therefore I B equals ¼ the difference between the given major and minor axes, and as the whole line, M B, by principle equals half the major axis, therefore the part I M, viz. the outer arm, L, of the above epicyclic elliptograph equals ½ major axis – ¼ (major – minor axis) = ½ major – ¼ major + ¼ minor axis, viz. ¼ (major + minor axis) which is also according to the rule for setting the outer arm, L, of the above epicyclic elliptograph. And from the above proof, showing that with the outer arm M I = ¼ (major + minor axis) and the inner arm I G = ¼ (major – minor axis), and the angle C I W always = angle I G Z, any point M on C M will describe an ellipse. It can also be shown that if the inner arm H′, viz., G I′, be made = ¼ (major + minor axis) and the outer arm L′, viz., M I′, is made = ¼ (major – minor axis), the point M on the shorter outer arm M I′ will also describe a similar and equal ellipse. Let the longer inner arm I′ G be drawn parallel and equal to the longer outer arm M I in any position as given above; then if the end M I′ and I G be joined, M I′ G I will be a parallelogram, and the side I G will represent the shorter inner arm as given above, and it will be seen as follows that the shorter outer arm of the above elliptograph, viz., M I′, being set equal to the side M I′ of the parallelogram M I′ G I will also coincide with it.

For M I produced being drawn parallel to I′G, the angle I B Z will equal angle I′G F, and, as shown above, angle I B Z equals angle I G Z, therefore angle I′G F equals angle I G Z; and as, by the above description of the motion of the elliptograph, the whole angle C I G or M I′G is in any position twice the equal angles I G Z or I′G F, consequently the angle C I G equals the angle M I′G, and therefore the shorter outer arm M I′ being set equal to the shorter inner arm I G will also coincide with the side M I′ of the parallelogram M I′G I, and its end M with the end of the longer outer arm I M in any position; and, as shown above, the end M of the arm I M will describe an ellipse, therefore the end M of the shorter outer arm M I′ will also describe a similar and equal ellipse.

ELECTRIC BURGLAR ALARM.

[Patent No. 13,525. 1884.]—In this invention by H. C. Roome, Jersey City, U.S.A., each building or structure to be guarded is connected electrically with a differential galvanometer or relay electro-magnet at a central office. The galvanometers or relay-magnets are normally balanced by resistances in the office equivalent to those of the external circuits, and should the resistance in any external circuit be varied by an attempt to open a window or door, &c., the galvanometer or magnet in the circuit completes the circuit of a relay for raising an alarm in the office. Mechanisms are placed in the office and in the external circuits and actuated by increasing the current, to introduce corresponding resistances into the external and office circuits at intervals, with the object of preventing any person from obtaining a knowledge of the resistance in circuit. The galvanometers or relay-magnets are cut out of circuit while the resistances are charged to prevent a false alarm, due to the resistances not being introduced simultaneously into the two circuits, and the battery power for effecting the charge is at the same time introduced by a compound key. One resistance-charged mechanism may be employed at the office to charge the resistance in any number of alarm circuits by replacing it by rheostat resistances after the resistance in any circuit has been charged. When the door, &c., of any guarded structure is opened, part of the resistance in its circuit is short circuited, thus giving alarm, and the short circuit is maintained by a short circuiting mechanism in the external circuit, even should the door, &c., be closed again. The short circuiting mechanism may be shunted out of circuit by an electro-magnet excited from the office. Electro-magnetic apparatus is provided for giving alarm when the battery becomes inoperative. This invention is somewhat related in principle to our system of fire-alarms introduced by Sir Charles Bright. It is ingenious and not very complicated, but its adoption would involve the laying or erection of a new system of wires—a serious objection in English towns.

ORNAMENTING GLASS.

[Patents Nos. 12,901 and 12,902. 1884.]—The object of the first of these patents, by J. Budd, 3, Finchley-road, Surrey, is to impart to sheets of glass the appearance of marble, malachite, onyx, or other stone, for use in the decoration of ceilings, &c. A tank is partially filled with a mixture of one part by measure of lime with two parts of water, and any ordinary pigments mixed with oil and of the tints desired are floated on the mixture. Any other mixture capable of floating the colours may be employed. The glass, prepared or not with gold size or other suitable drying material, is laid on the floating colours, which are thereby transferred to the glass. The veined or ornamented surface is then painted to form the ground, is coated with a mixture of shellac and plaster-of-paris or other backing material, and when dried is ready for use.

The second patent embraces a device for imparting to glass surfaces the appearance of mosaic work and the like, such as designs upon tiles, &c., chiefly for the decoration of ceilings, &c. The paste obtained by boiling down an aqueous solution of one part strontium nitrate with two parts of ordinary starch is applied both to the glass and to a paper lithograph of the design to be produced. The paper is then laid on the glass and the surplus paste squeezed out. The glass is dried, and the paper is reduced to a very thin film by sand-paper or the like, and spermaceti or paraffin wax is applied to form a protective coating and to impart lustre. The glass may also be veined or grained.

HANGING AND DRAWING CURTAINS.

[Patent No. 8,863. 1884.]—In this invention by J. Turner, 76, Hyde Lane, Hyde, Cheshire, the curtains are attached to tapes which are suspended by connecting to eyes cast into the balls sliding in a hollow or grooved pole, the eyes projecting downwards through a slot. Cords passing over pulleys through central holes in the balls, and crossing at the centre, are brought down at the side and may be suitably secured. The inner balls are fast to the cord, the outer ones to the pole. By pulling either cord, as the case may be, the curtains are drawn or withdrawn.

LARYNGOSCOPE.

[Patent No. 10,849. 1884.]—A. H. Vesey, 8, Upper Bedford-place, W.C., has patented this instrument, in which a small incandescent electric lamp is partially imbedded in some non-conducting material, as cement, contained in a casing which is fixed by a bayonet joint within a tube lined with insulating material, to which is attached a German-silver tube of small diameter, containing the wires conveying the current. On the silver tube slides a piece carrying a rod with a mirror at one end, so that the light may be reflected as desired. At the end of the tube is an ebonite handle, containing a switch and resistance coil, so that the strength of current may be regulated. The connecting wires project from the end of the handle, and are connected to a battery.

LONDON INSTITUTION.—Two lectures were delivered by the Editor of KNOWLEDGE at the London Institution on Feb. 18 and Feb. 25, the subjects being "New Stars" and "Volcanoes." There is a greater connection between these subjects than might at first sight have been supposed. Mr. Proctor showed that new stars indicate disturbances in our stellar system akin in character to volcanic disturbances in a planet. They are casual or accidental phenomena, and do not belong to steady life-processes. He showed that new stars occur in unfinished regions of our galaxy, in star clouds, star clusters, regions of star mist, &c., as is shown by coincidences altogether too numerous and too striking to be accidental. (In passing he presented the thought that the Magellanic Clouds really may be external galaxies—or else outlying parts of our own galaxy.) In dealing with volcanoes, he showed that they belong to the astronomical at least as much as to the geological aspect of earth-study. He found in the moon evidence of volcanic action such as took place in the past on the earth, the traces having however been removed. He traced comets to volcanic action in terrestrial planets, in giant planets, and in the suns which people space.

CONTENTS OF No. 4.

	PAGE
The Unknowable; or, the Religion of Science. By R. A. Proctor	105
The Story of Creation: A Plain Account of Evolution. By Ed. Clodd.	107
Historical Puzzle. By Richard A. Proctor	109
Coal. By W. M. Williams	111
Modern Analytical Chemistry	112
The Story of the Earth	113
Optical Recreations: Colour and Light. By F.R.A.S.	115
Notes on Earthquakes. By Richard A. Proctor	117
The Night Skies in Australasia, Cape Colony, &c. (*Illus.*) By Richard A. Proctor	120
Indian Myths. By "Stella Occidens"	121
Origin of Comets and Meteors. By Richard A. Proctor	123
Bad Times	125
Geology in London. By W. Jerome Harrison	128
The Migration of Abram	129
Our Mammal Cousins	129
A Positivist View of the Sermon on the Mount	130
Gossip. By R. A. Proctor	131
New Books to be Read—and Why	134
Whist	135
Chess: An Improved Scale of Odds at Chess. By "Mephisto"	135

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